International Rail
Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9500

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Publisher
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International Railway Safety Seminar

MAINZ GERMANY

09. - 11. OCTOBER 1995

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International Railway Safety Seminar 1995

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List of Delegates

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Aspects of Safety within Privatised UK Railway

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I/1 David Rayner

Aspects of Safety Within the Privatised UK Railway

ADDRESS TO THE INTERNATIONAL SAFETY SEMINAR, MAINZ
OCTOBER 1995

Aspects of Safety Within the Privatised UK Railway

D E Rayner, Director, Safety & Standards, Railtrack PLC

In the UK there remains real public and therefore political interest to see that railway accidents remain rare occurrences and that, in the minds of rail passengers, the perception of travel risk is so low as to be insignificant to their travel decision.

There is a concern that the privatisation of the industry, which public and media, not to mention quite a few politicians, see as so complex as to be incomprehensible, is not going to allow safety standards to deteriorate and place passengers unwittingly, so to speak, at added risk. The matter is not helped by a wave of scare stories in the press.

So, the railways commitment to continuing to offer perceptibly safe service is a real issue and a live one. Real safety improvements, across the spectrum of the at-risk groups of staff, public and passengers have been achieved by dint of hard work by rail managers and staff over recent years, but have been aided, and in my view, accelerated by a clear vision of what the industry was aiming to do, where and in what measure.

Immensely helpful, I believe, has been the adoption, in the UK, of a "tolerability of risk" approach to safety hazards and accidents, utilising Government Safety Agency (HSE) guidelines and targeting safety performance to drive improvement in focused areas.

The HSE philosophy identifies upper and lower limits of tolerability, and recommends - indeed increasingly requires - owners of risk activity to so manage their operators as to be within these tolerability thresholds.

Once inside, then the HSE philosphy suggests that risks be controlled to a point "as low as reasonably practicable", weighing up the costs, consequences and measured risk diminution that safety improvement measures would generate.

These concepts of risk tolerability and reasonable practicability have had a ready applicability to railways in Britain keen to modernise their safety management practices and have had a major impact on our thinking which has enabled the industry to focus on its safety performance and drive hard towards significant improvement.

Within the defined upper and lower limits of tolerability of 10^{-3} or 1 fatality in 1,000 for staff or 10^{-4} or 1 in 10,000 for public, and 10^{-6} or 1 in one million, the rail industry in UK first established medium term aims of achieving :

- exposed workforce performance at 10^{-4} - 1 in 10,000 fatalities p.a.
- passenger safety performance at 10^{-5} p.a. (based on a regular passenger making 500 journeys per year)

and

- public safety performance at 10^{-6} - 1 in a million p.a. - where members of public were involuntarily exposed to railway activity at level crossings, footpath crossings as neighbours etc!

These medium term aims had the benefit of a simple economic order of magnitude relationship of exposure and benefit and were at levels which were, it was believed, attainable through realistic effort and expenditure.

Most importantly, the Government Safety Agency made it clear that by aiming for, and ultimately achieving these medium term targets, then the regulatory environment in safety could also be better focused, and not to put too fine a point on it, freed of overprescriptive and sometime idiosyncratic enforcement that resulted from a vacuum in performance strategy. Their recent decision to replace their prescriptive technical standards regulations with "Safety Principles" applicable to the Railway Group would seem to confirm this.

The results of the application of this philosophy to railways are, of course, well known, via the industry annual Safety Plans. Objectives for targeted improvement have been set and significant improvement achieved.

Most spectacularly (and most satisfyingly) in worforce safety, where the performance for the most vulnerable, trackside workers, has moved from close on 10^{-3} (1 in 1,000) at the edge of tolerability to better than 10^{-4} (1 in 10,000) in the last four years, thereby achieving the medium term objective, through major effort, much earlier than ever we imagined possible.

Passenger safety too has improved and for the last three years has been better than 10^{-5} or 1 in 50 million journeys target - thanks to much work done beefing up the management of carriage door safety.

And public safety will undoubtedly respond to the focused work being done in level crossing performance, fencing programmes and trespass and vandalism initiatives now applied on a localised basis.

But there are issues on the horizon posed by the structure of the UK industry after privatisation.

The first issue that we have to recognise is that, in the new structure many, indeed most of the operational units, the train companies and the infrastructure maintenance companies, will be of a size where the incidence of accident, incident and mishap is likely to be so infrequent that it is impracticable to measure output performance in a statistically reliable way relative to the setting of annual, tolerability based, objectives. Most train companies will not have a passenger movement fatality most years and most infrastructure units will not have a trackside worker fatality most years. Thus there are limitations on continuing with the present system of objectives beyond the letting of the passenger franchises and the sale of the infrastructure maintenance units.

It will also be necessary to take steps to ensure the quality of reporting of incidents is maintained. This is proving to be an important issue, and whilst in part it will be addressed with the implementation of a much more user friendly system for incident reporting, and reinforced by commitments made formally in Safety Cases, I believe that inherently there is something of a vicious circle that output-based objectives may stimulate less than rigourous output reporting by some organisations, which in turn may debase in the minds of other operators the concept of industry objectives in which all the players participate. Much essential data for risk management decisions could also be lost.

It therefore seems to be, and my colleagues in Railtrack, that, as the Infrastructure Controller for the UK main line railways, we need to rethink our approach to industry Safety Objectives, to preserve such a useful driving force for safety improvement and which, additonally enables us to demonstrate very publicly and effectively the industry's commitment to safety improvement.

Our initial thoughts lead us to contemplate some revisions in the conceptual framework of safety objectives on the following lines. These would not be objectives in the proper managerial sense of being allocated to particular individuals having the responsibility and hopefully the power to achieve them. Rather, they will represent the shared aspirations for the whole range of safety measures across the industry :

Firstly, Railtrack as the Infrastructure Controller, will continue to set industry performance objectives based on tolerability of risk levels for passengers, public, exposed workforce and perhaps some others. Railtrack will measure overall performance as it does now and, in the annual Railway Group Plan, will report publicly on the achievement of these objectives by the Railway Group, as one unit. This will largely address the issue of Public and Regulatory scrutiny of overall industry performance.

Secondly, Railtrack will, however, in conjunction with individual companies, work to identify and segment those risk areas of vulnerability which principally contribute to the fatalities, injuries and major losses that the industry suffers i.e. SPADS, vandalism, trespass, doors etc. and we will identify as best we can the relative contributions of each risk segment. Furthermore, we will identify who amongst the individual companies has responsibility for managing the segmented risks.

By way of illustration and using recent accident data, and for the sake of this example, only counting fatalities, we are able to construct a crude weighted attribution using a value of preventing fatality (VPF) approach where the VPF units are 3 for passenger or staff fatalities in a train accident, one third for a trespasser, one tenth for a suicide and one for all others, ie passengers and staff in movements and non-movements accidents, public at level crossing accidents, persons on business etc.. I stress these are example values only.

Thus, overall responsibility would divide as follows :

Railtrack :	trackside staff		
	non-staff on track		
	level crossings		
		In total :	43%
Railtrack prime			
Train Companies assisting:	SPADS		7%
Train Companies prime :			
Railtrack assisting :	door related passengers		
	passengers on stations		
		In total :	14%
Both Railtrack	other train accidents		
& train companies showed:	other than trackside staff		
		In total :	22%
Neither :	Suicides		14%
		Total :	100%

In this example, infrastructure companies are assumed to respond to Railtrack direction, as their contractors.

Thirdly, we will then expect to see against each of the risk "objectives" above, a response by every company concerned, through its own objective setting process, setting out a plan of improvement with mileposts, targets and success criteria against which Railtrack, as Infrastructure Controller, can audit progress and achievement.

This represents a first conceptual approach to reformulating safety objectives into a workable framework; it maintains overall surveillance of output safety performance, but does enable the industry to demonstrate commitment to improvement, and, for the most part I hope, actual objective evidence of incremental improvement.

Importantly, it also offers a framework for addressing the issue of catastrophic multi-fatality safety ie train crashes which the present system of objectives does not handle well.

It would not be my intention for Railtrack S & SD to be excessively intrusive in the audit of these arrangements, but sufficient to demonstrate objectively that each organisation or company is active, and focused, in its safety improvement activities. This has benefits for both sides.

Those are our preliminary thoughts which we are currently sharing with the new rail companies (and with BR who at this point in time still own them), as part of the 1996-97 safety plan consultation exercise.

There will, of course, be those who will say, against the background of intense commercial pressures, why improve on an already high safety record. To them I would say that the railway world will not stand still. Public expectation of service standards, whether it is of safety or other quality factors is continually moving on. It is driven by comparison with other transport modes and other operators. Railway people I believe tend to be too complacent about the comparisons between railway safety and that of other, private sector modes. Complacency is not justified.

Air safety is in important ways much better than rail safety, with fatalities per passenger kilometre a quarter or less than that for rail.

Road safety is indeed much worse than rail's, but not so much as to justify complacency. The comparison between InterCity-styles of travel is much closer than many realise, with UK motorway casualties per passenger kilometre 27% of the road average, including pedestrians as well as vehicle occupants. The motorway level is not hugely different from that of rail, if we take into account our pedestrian casualties (who we have tended to dismiss in the past as "trespassers").

And road safety in the UK, as elsewhere, has been improving rapidly; the fatality rate per vehicle kilometre has been falling consistently at 6.4% per year since 1980, giving a cumulative fall of 60% over the period.

Some part at least of the European railways' claim to subsidies rests on the belief that displacing traffic from rail to road would mean that more people get killed and injured. Under privatisation British subsidies are liable to be under greater scrutiny than before. To sustain the subsidies, we need to sustain the belief in our superior performance. And the best and ultimately the only way to sustain that belief, is to sustain the fact i.e. to keep improving at least as fast as road safety improvement.

We also need to be aware that the philosophy behind the Government Safety Agency in Britain is one of continuous improvement of safety performance to a point of acceptable tolerability. And that is defined by the Agency as being the far side of 10-^{6} - a state not yet achieved by any of the categories of railway "stakeholders".

So, the commitment to improvement is, I submit, a given and requires our attention.

However, it is not unreasonable for the management's of the train companies and their suppliers to ask for some guidance on this concept of reasonable practicability of safety improvement.

The formal Agency position is that, within the envelope of safety performance where the concept applies, the "as low as reasonably practicable" area, then improvement should proceed when the benefits of improvement exceed the costs of achieving it.

The valuation of safety benefit is a difficult area and practice round industry varies. Elaborate studies have endeavoured to evaluate the actual costs of accidents, and put values on a life lost, a major injury and so on.

In the UK, the transport industry has adopted a rather different, but I feel more objective approach.

It is based on the rational assumption that the traveller, if he or she values personal safety, or the parent or spouse if they value the personal safety of a family member will be prepared to pay incrementally a higher fare or price for travelling if the journey or the travel means is incrementally safer. This rationale is then put to the test through user research to evaluate the extent of willingness to pay.

The Transport Ministry in UK has commissioned such research, and in a generalised model, has established that, at the bottom end of the range, the typical traveller seems to be prepared to pay equivalent to about £800,000 being expended for each incremental fatality avoided.

Moreover, the research has probed the area of personal injury and has derived values for the avoidance of serious and less serious injuries.

This work, albeit orginally commissioned for use in road safety evaluation, has seemed to us to have relevance to rail and an application in our own industry. Work separately commissioned by both London Undergound Limited and by Railtrack has established that, whilst the base figure of around £800K seems to hold reasonably good for what I might term "low profile" individual rail injuries and fatalities, there are "aversion factors" in rail accidents - scale of accidents, lack of individual control - for which rail travellers are prepared to pay incrementally higher to avoid. Our research suggests that passengers' willingness to pay could rise to as high as £2m per fatality avoided in specific circumstances of multi-fatality and nastier rail accidents.

Interestingly, the factor of scale - the number of people liable to be killed in a single accident of a particular type - is emerging as perhaps not such a major factor with the general public. It used to be taken as read that multi-fatality risks carried much higher willingness-to-pay valuations than those where only individuals or twos and threes, were at risk in any one event. But recent research suggests that people's concern about this aspect of risk is counterbalanced by, among other things, their realism about management's ability to deliver solutions to this sort of risk. It also suggests that what is important to them is whether the victim has control over the situation, and whether the circumstances are unusually strange or horrifying (eg. underground). While this still leaves train accidents as weighing considerably heavier with the public than the general run of road and similar accidents, it does considerably simplify analysis - no more call to attempt elaborate predictions of the frequency distribution of accidents from one fatality up to 200.

The important conclusion is that there is a rational approach to the issue of what it is reasonably practicable to do in the pursuit of safety improvement, and the approach is via a concept of value of preventing a fatality used as a conversion factor to bring the units of expression on both sides of the cost benefit equation to the same commodity - money.

That this methodology is now an acceptable and proven approach to rail safety has been effectively demonstrated by the Safety Agency's recent endorsement of the BR and Railtrack evaluation of Automatic Train Protection (ATP), which was commended by the Agency for its approach and methodology, and had their support for its overriding conclusion that a system wide and costly installation of ATP should not go ahead because the costs of its installation significantly outweighed the incremental benefits of safety improvement.

Even here, though, there is an issue for us in the privatised railway and it is this:

there will naturally be a temptation on the part of some companies to adopt their own value of life either for business or image reasons. That is fine, providing those companies who adopt values that are above minimum value that would apply across the industry carefully record that their valuation of life is at a premium. Should they, however, seek to argue lower values for their own application then, I believe, they could bring the system into disrepute with Government, the independent Rail Regulator and perhaps even with OPRAF, the funding body, and certainly I believe with the media and the public.

Railtrack therefore believe that there is strong merit in the UK rail industry formally adopting the Government set of values, which index links the basis value of an individual life saved to reflect inflation and increasing real incomes, uses standard major and minor injury conversion factors and which discounts life values over time in the derivation of cost benefit results.

It seems to us that by using this basis, and then by exercising judgement over whether the base value or higher ones - reflecting particular aversion factors and applied against industry guidelines - are used in the interpretation and decision making process following cost and benefit analysis (CBA) - then the rigour by which the industry approaches safety improvement is publicly defensible.

I also see major advantages for the multiplicity of individual organisations which will make up the railway in the future. Commitment to cost-benefit analysis as the way safety decisions are taken, together with clear, comprehensive and consistent rules for conducting that cost-benefit analysis, enables devolution. When an operator plays by these rules, he has no need to negotiate the answer with Railtrack S &SD and S & SD have no need to breathe down others' necks.

We are already seeing the results within Railtrack itself. Most decisions are found to take themselves, in the sense that safety benefit is not material to the decision. In many cases, commercial consideration on their own point to the safety-positive decision, and bringing safety benefit into account is superfluous. In others, no credible assessment of safety benefit would alter the decision.

This is salutary for us safety professionals. We shall get no medals for interfering in decisions which are going our way without the complications of safety risk analysis. This is likely to be the case with the great bulk of engineering and operating decisions designed to improve reliability and timekeeping - i.e. much of what underlies minimising train accident risk.

At the other end of the scale, the rules of safety CBA prevent us from advocating measures whose costs outweigh the benefits, including safety benefits assessed according to the rules. In effect, once a particular measure has been identified, specified and assessed, the focus of the safety professional is within that margin between the low-tide mark below which lie the measures which are economic without reference to safety benefit, and the high-tide mark above which lie measures uneconomic from any angle.

This does not diminish the proper scope for safety professionals, but helps direct it. It focuses us on the stages prior to the cut-and-dried cost-benefit analysis; first, on identifying Cinderella risks, i.e. those not being given due attention; second, on devising new options to reduce risk; third, on helping people do their assessments properly. It forces us to be creative.

And, as the ATP case history has shown, the industry can then defend rational decisions in the face of knee jerk pressures for highly costly measures in reaction to catastrophic, but very infrequent, high consequence accidents.

In summary, colleagues, the identification, through a public plan of safety objectives, of risk areas for management action, together with a rational approach to value for money, reasonable practicability and prioritisation of spending and resourcing, endorsed by best practice elsewhere, are, I believe, two of the most important issues for the management of the newly structured UK railways to understand and to practice and of significant interest and perhaps emulation to colleagues from other Administrations.

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Paul Godier

Risk Assessment and Mitigation: A Case Study on the platform/train interface - LUL

Publisher
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I/2 Paul Godler

Risk Assessment and Mitigation
A case study on the platform/train interface

INTERNATIONAL RAILWAY SAFETY CONFERENCE

Mainz

October 1995

Reducing risk at the platform/train interface

Paul Godier
Head of Safety Development

LONDON TRANSPORT

REDUCING RISK AT THE PLATFORM/TRAIN INTERFACE

Paul Godier, Head of Safety Development, London Transport

1. Introduction

1.1 Following a customer fatality at Hounslow East station on the Piccadilly line in January 1993, a senior management review was conducted, led by the General Manager of the line. The incident involved an elderly female customer, who fell back against the train after alighting, then fell between the train and the platform edge as the train departed, and was subsequently killed. (The platform at this station is curved, causing gaps between the platform and train.) The review also examined previous similar incidents, whether fatal or not. As a result, one recommendation of the review was the formation of a Platform/Train Interface Group, to act as a focus for improving the safety of customers boarding and alighting from trains.

1.2 In conjunction with the Railway Inspectorate, a study was commissioned in 1994 from a UK safety consultancy (Four Elements Ltd), to review the existing risks, and the possible measures to reduce the frequency and/or consequences of the hazards. The efficacy of the possible measures was reviewed, and a preliminary cost-benefit analysis was made.

1.3 As a result, the most promising measures are now being developed in more detail.

2. The risks

2.1 The existing level of risk at the platform - train interface has been assessed using historic data, principally from the LUL's incident database. The five categories of incident reviewed are:

- person falling under train
- person on track
- caught in doors
- fall between train and platform
- fall between cars.

As far as possible, suicides have been excluded from the data.

2.2 Almost four years of data (46 months) were analysed, and the results are summarised in Table 1 below. There were a total of 12 fatalities in the period, during which almost 4 billion passenger journeys took place. This therefore represents a very low level of passenger risk, but it is nevertheless right that LUL should examine whether there are worthwhile measures that can reduce the risk still further (to achieve levels of risk that are low as reasonably practicable).

Table 1. Incident Data Summary - Platform/Train Accidents (Jan 1991 - Oct 1994)

	Caught in doors	Person under train	Person on track	Between train & platform	Between cars	All
Fatality	3	8	0	0	1	12
Major injury	2	16	5	8	2	33
Minor injury	456	6	85	177	9	733
TOTAL	461	30	90	185	12	778

In total the approximate loss to society from these accidents equates to some £10m per annum, based on statistical values of life and injury from "willingness to pay" research..

3. Risk reduction measures.

3.1 A knowledgeable group was used to generate suggested measures that could reduce the frequency or consequence of these types of accident. A short list of measures for evaluation was drawn up, comprising:

Train based
- closed circuit television (CCTV) monitors in cabs, to view platform
- train borne passenger emergency alarm (PEA) automatic braking system
- Emergency Stop Plungers (ESPs) on train exteriors
- inter-car barriers
- improved door engineering/control mechanisms

Station based
- passenger operated emergency stop plungers (ESPs) on platforms
- platform edge doors (PEDs)
- platform surveillance using CCTV
- reducing gaps between platform edge and doors

People based
- guards on trains
- platform attendants with access to emergency stop plungers
- platform attendants with access to emergency stop plungers only at busy Central London stations during peak periods

Each of these measures is described in more detail in Appendix 1.

3.2 For each of the potential risk reducing measures, an estimate has been made of the extent to which the measure might reduce either the frequency of the incident arising, or the severity of the consequences. The reduction in consequence was considered in terms of the effect the measure could have on the probability or death, or major injury - each probability considered separately. The effect of each measure was estimated by a knowledgeable group, including operating managers, staff safety representatives, and human factors experts.

3.3 Using the example of CCTV in train drivers cabs, this facility would reduce the frequency of person under train incidents, because the driver will be able to see a platform ahead before entering it, and hence have a greater chance of stopping before reaching a person on the track. The measure will not be fully effective because there will still be people falling onto the track too close to the train for the driver to stop, and driver vigilance will not be total. In-cab CCTV will be an improvement on platform mounted monitors for departing trains, because (a) the images will be clearer (e.g. not affected by sunlight on the monitor, or rain on the windscreen); and (b) the driver can continue to observe the platform after the cab has passed the platform headwall and entered the tunnel. This will reduce the consequences of incidents involving people trapped in doors, and falling between train and platform, or between cars. The reduction in the severity of incidents where a passenger is caught in the doors is judged to be greater than for the other two types of incident, because it is felt that a person caught in the doors is more likely to be observed by the driver.

3.4 The impact of Cab CCTV on risk is summarised in Table 2.

Table 2. Risk reduction summary table - Cab CCTV

Incident type	Reduction in:		
	Frequency	Pdeath	Pmajor injury
Caught in doors	0	80%	80%
Person under train	40%	0	0
Person on track	0	0	0
Fall between train & platform	0	60%	60%
Fall between cars	0	60%	60%

3.5 Similar tables were generated for each measure. In addition, a review was conducted of the measures used by other Metros. The results, for the metros that responded, are summarised in Appendix 2.

4. Cost-benefit analysis

4.1 For each measure, the installation and running costs were estimated. The benefits of the estimated reduction in fatalities and injuries was calculated using a valuation for avoiding a statistical fatality of £2m, and associated values of major and minor injuries at 10% and 0.5% of the value of a life respectively. Such valuations are broadly in line with valuations adopted within the UK transport sector.

4.2 The impacts of the measures on passenger delay were also assessed from historical analysis using a mathematical model of the train service. There are two categories of impact:

(i) a benefit in reduced delay to passengers if the number of incidents are reduced; and
(ii) a disbenefit for Emergency Stop Plungers that are accessible to passengers, because they can be misused and cause unnecessary delay (this was estimated from historical experience on the Victoria line, which has three ESPs on each platform).

The train service model was used to estimate the average delay for peak and off peak incidents, and the time gain/loss to passengers valued using the estimated value of time. These effects also generate (or reduce) demand, and hence affect revenue.

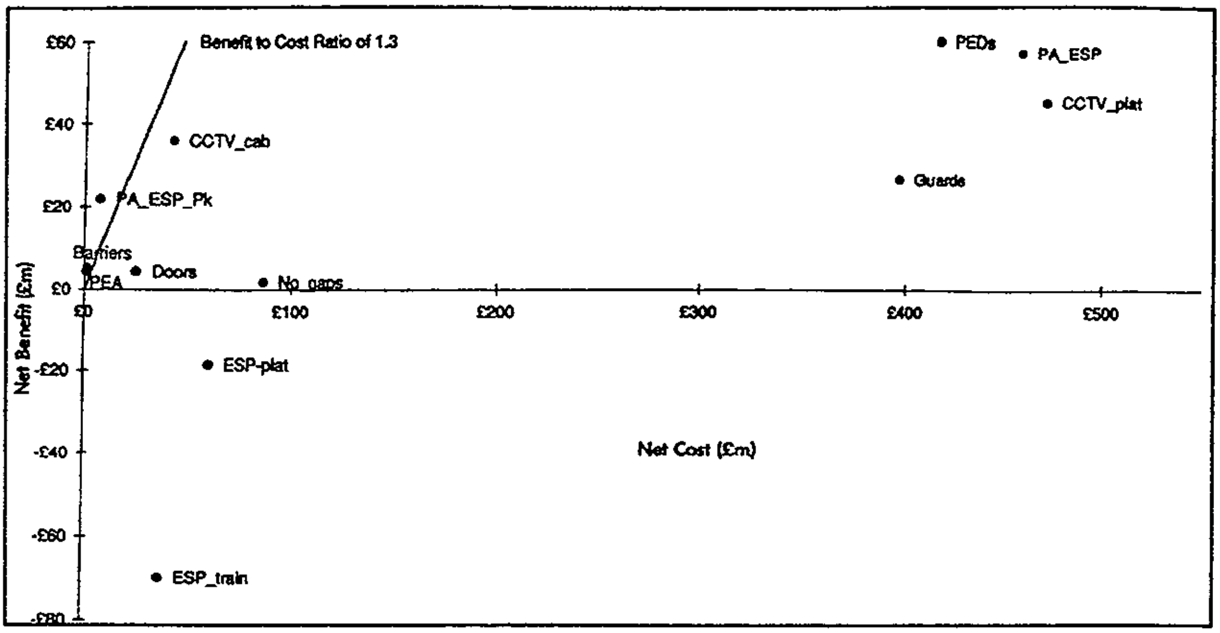
4.3 Allowance was made for measures that could not be implemented across the whole network (for example Platform Edge Doors were not assumed to be feasible at stations served by a mixture of rolling stock types with doors in different locations). Benefit was not ascribed on those lines where the measures are already installed or on order (eg the Central line already has in-cab CCTV; the Victoria line already has ESPs; the Northern line currently has guards).

4.4 All the costs and benefits for each measure were then discounted to present values using a discount rate of 8%, and a benefit:cost ratio calculated.

5. The results

5.1 The results of the analysis are summarised in the scatter graph (Figure 1), which plots the net cost and net benefit of each measure. The "passmark" benefit:cost ratio for LUL is 1.3 to 1 and is shown as the diagonal line on the graph. This divides the worthwhile schemes from the unworthwhile.

Figure 1. Net cost/net benefit scatter plot



5.2 Two measures have a negative benefit - platform ESPs for use by passengers (ESP_plat), and ESPs on the outside of trains (ESP_train). There is a low chance of them being used successfully by passengers in an emergency; they are open to abuse; and the ESPs on the outside of trains could also cause accidents if attempts are made to use them whilst the train is in motion. Other measures, whilst showing significant net benefit, are not cost effective. These are:

- Guards
- Platform edge doors (PEDs)
- Platform attendants with access to an ESP (PA_ESP)
- Increased surveillance of platforms by CCTV (CCTV_plat)

In the case of PEDs, the main cost is installation, whereas the other measures are dominated by staffing costs.

5.3 Two further measures are similar:

- Reduction of gaps between platform edges and trains (No_gaps)
- Improvements to train door engineering and control mechanisms (Doors)

They both have small net benefit, and poor cost-benefit ratios. They both address essentially one category of incident, neither of which is "person under train" which historically has caused the majority of fatalities.

5.4 Four measures have been selected for further consideration, in the light of the findings. These fall into two categories:

- Passenger emergency alarms (PEAs), and
- Inter-car barriers (barriers)

These have the highest benefit to cost ratios, but this is because of their relatively low cost (the net benefit is limited).

- In-cab CCTV (CCTV_cab), and
- Targeted use of platform attendants with access to ESPs during peak hours (PA_ESP_Pk)

The former is reasonably cost effective, with high net benefit. Although the benefit:cost ratio is only 0.86, this option will be further developed, by piloting the retrofit to two trains and platforms on the Piccadilly line, using two "ship to shore" communication technologies (infra red and microwave links). This will enable a better assessment of the costs of retrofitting to existing train fleets. This measure also has some potential benefit in reducing suicides, not included in the evaluation. Peak hour platform attendants with ESPs are also worthwhile, because this option uses existing staff, and - as with in-cab CCTV - it reduces the likelihood of fatality or major injury for three categories of incident (caught in doors; fall between train and platform; fall between cars), as well as reducing the frequency of person under train, because it could be activated prior to a train entering a platform, in the event of a person falling onto the track.

5.5 For the three clearly worthwhile measures (barriers; PEAs, and peak platform attendance with ESPs), technical specifications and more detailed cost-benefit evaluations are proceeding, with a view to placing contracts. The option of emergency stop plungers for staff will not be fully developed until experience is gained of the stop plungers being installed on the Central line. The option of a hand held remote control plunger for staff may be developed instead of fixed location plungers. Final evaluations will review the combined value of any package, to avoid double counting.

Description of the risk reduction measures considered.

Train based

CCTV in cabs to monitor platform - As fitted to new Central line rolling stock, designed to be activated before entering the platform ahead, and then giving the driver a continuous view as he/she enters the platform, whilst loading/unloading takes place, and then showing the platform until the train has fully departed.

Train borne passenger emergency alarm (PEA) causes braking - At present, PEAs in saloons alert the driver. The driver should then apply the brake if any part of the train is still in the platform, but proceed to the next station otherwise. (A trackside marker indicates when the train has fully departed the platform.) The proposed risk reduction measure is to link the PEA to the train braking system so that the brake is automatically applied if part of the train is still in the platform. This cuts out the reaction time of the driver, or the potential confusion as to whether the marker has been passed or not.

Emergency stop plungers (ESPs) on train exteriors - These would be placed at intervals along the train, and directly activate train brakes

Inter-car barriers - A flexible barrier (as on New York subway system) between cars, to reduce the chance of some one falling between the cars, or mistaking the gap between cars as a door aperture (ie the visually impaired). Design should prevent use by "surfers".

Door engineering/control mechanisms - Reducing door closed tolerance to 6mm. Fitting "door closing" audible warning. Stiffer door edge rubbers. Upgrading existing doors to original design standards.

Station based

Passenger operated emergency stop plungers (ESPs) - Wall mounted alarms at intervals along the platform for use by passengers and staff. Operation illuminates a red signal ahead of the train to warn the driver to stop immediately whilst entering or leaving a station. On lines with automatic train operation (ATO), the ESP would automatically stop the train.

Platform edge doors (PEDs) - Fitted along the full length of the platform, and interlocked so that they only open when a train is correctly berthed, and are proved closed before a train departs. Capable of installation without causing temporary line closure. Battery backed. Manually openable from the train side in emergency.

Increased platform surveillance using CCTV - Station staff monitor all train departures via CCTV from a central point on the station, with access to an ESP to alert the driver to stop.

Reducing gaps between platform edge and doors - Platform gaps modified to meet a maximum gap criterion of 150mm vertically and/or horizontally, except where platform curvature prevents this.

People based

Guards on trains - positioned at the rear of the train, with access to an emergency brake. Operates the doors, and observes the initial stage of the departure of the train from the station.

Platform attendants with access to emergency stop plungers - The attendant would be positioned in a prominent position on each platform, with visibility along the whole of the train. He/she would have access to an ESP with which to stop the train in an emergency. The ESP would be located in the attendants position only, and would not be available for passenger use. It would operate a red warning light at trackside, on entering or leaving the station, to alert the driver to stop. On lines with automatic train operation (ATO), the ESP would automatically stop the train.

Platform attendants with access to emergency stop plungers (busy central London stations at peak periods) - As above, but only at those stations where staff are already on duty on platforms during the peak periods. This reduces the cost of the measure.

Appendix 2

Summary of risk reduction measures used in other cities

Risk reduction measure	Paris Metro	Paris RER	Paris Meteor	New York	Singapore	Hong Kong
Guards				√		
Platform attendants with ESPs						√
Platform ESPs for passenger	√				√	√
ESPs on trains						
Train PEA braking	√		√			√
Minimise gaps	√	√	√	√	√	√
Inter-car barriers				√		
In-cab CCTV					√	
Platform edge doors			√		√	
Platform surveillance by CCTV	√	√	√		√	√
Improved train door engineering				√		

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Edwin Griffioen
Jan Stuifmeel

Risk and Failure Analysis
An Integrated Approach

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I/3

Edwin Griffioen, Jan F.E. Stuifmeel

Risk and Failure Analysis
An integrated approach

Risk and Failure Analysis
An integrated approach.

E. Griffioen and J.F.E Stuifmeel
Railned Railway Safety
Netherlands

October 1995

INTRODUCTION

Any activity we carry out is subject to risks, including the running of trains. Risk analysis is the method we use to identify, assess and evaluate such risks, with the objective of reducing or avoiding them. In basic terms, risk analysis consists of the following steps:

- describing the system in question;
- identifying the undesirable events that might arise from the activity;
- quantifying the likelihood of the undesired events occurring;
- quantifying the consequences for people and the environment of the occurrence of these events;
- presenting the results in the form of a qualitative and quantitative profile of the risk associated with the activity;

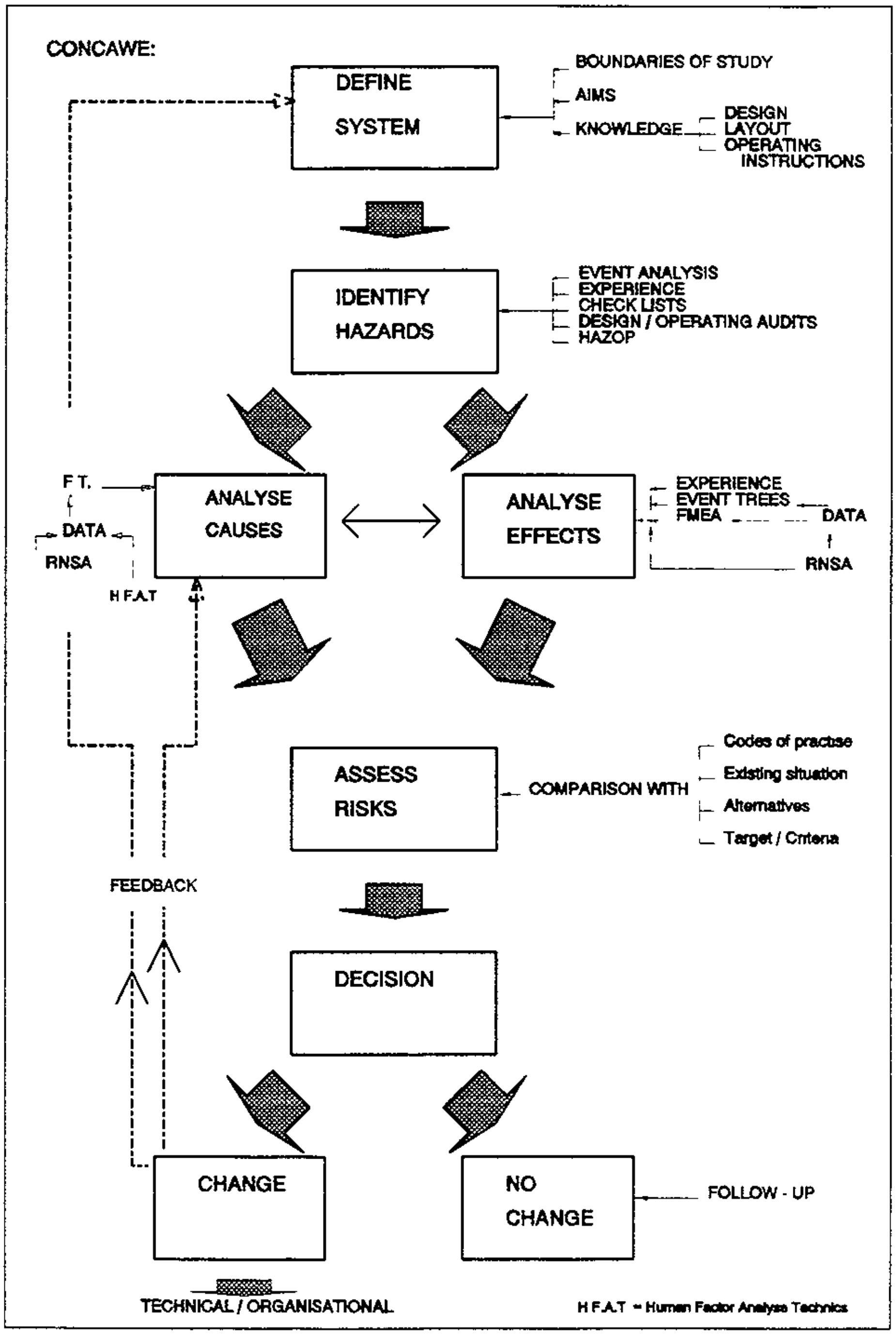
Standards are then established by which to determine whether or not the calculated risks are acceptable. Wherever possible, risks are reduced by preventative measures, and if this cannot be done, by curative or effect-orientated measures. Risk analysis techniques are generally used to study existing systems, but they have also been applied in recent years for assessing the potential risks entailed by new designs. The approach is somewhat different in this case, however, in that the design is first established, and risk analyses are then used to develop supplementary measures to limit the risk associated with the design. The measures in question often consist of formulating procedures and/or optimising training.

There has also been a growing recognition in recent years that human actions are a significant cause of incidents and accidents. Literature on the subject regularly indicates that 65% of accidents may be attributed to human error. A recent Safety Meeting held by railway companies produced figures of the same order of magnitude. As with risk analysis, consultation of a human factors expert is often left until too late a stage of the project. Consequently, the design has already been finalised and all that can be done is to provide advice regarding ways in which users can deal with the system. What this means in practice is that technology plays the decisive role in the design, and the user is obliged to adapt to it. However, from the point of view of safety, efficiency and the health and welfare of the user, the capacities and limitations of the human being ought to be the starting point for the design. The ideal approach to the design process would be to involve human factors and risk analysis at as early a stage as possible. It ought to be possible, in the process, to alter hardware, procedures and training in line with the findings of this analysis.

There is nothing new about the above approach, yet it is rarely applied in practice. This article describes how such an approach was adopted for a major infrastructure project, namely the preliminary study for the construction of the High-Speed Line London/Paris -- Brussels - Amsterdam. The possible inclusion of a 16 km-long tunnel raised particular questions regarding passenger safety. The design and layout of the tunnel are an ideal subject, as they often prescribe facilities, the effectiveness of which in the event of a disaster is doubtful. Above all, insufficient account is taken of the manner in which a disaster unfolds, especially the way people behave.

APPROACH

The approach is shown below in diagram form.



Define System

A risk analysis is first carried out at macro level. The High-Speed Line (HSL) is a response to growing demand for transport. This can be met in a number of ways: by building roads, by air and by rail (with or without the HSL). A number of different criteria (cost, environment, transport growth, etc.) contributed to the decision to construct a new line. As far as passenger safety was concerned, the overall risk was set against other means of transport. An approach was also selected whereby the safety risk was assessed across the route as a whole. In other words, risks had to be distributed evenly along the entire line. Matters affecting safety are:

- sealing off the track to maintain the safety of people passing by the railway;
- inclusion of 16 km of tunnel.

A preliminary study was initiated in connection with the latter aspect. The purpose of this was to examine the feasibility of different tunnel designs (drilled tunnel with two single tracks, drilled tunnel with double track, cut and cover tunnel with two single tracks, cut and cover tunnel with double track).

The following questions were put to the Railned Railway Safety department:

- Are the tunnel designs acceptable in terms of railway safety? What are the differences between the various designs in this respect?
- If not, what measures ought to be taken to produce a tunnel design that does meet safety requirements?
- If one or more of the tunnel designs meets the safety requirements, are there any measures that could be taken to reduce the risk further at modest cost (ALARP principle)?

Identify hazards

All accident investigations at Netherlands Railways for the past 15 years have been stored in a database (Safety Management System). This information was used to identify incidents that have occurred in tunnels. The following incidents entail a group risk: collision, derailment and fire in a stationary train. This article will focus on the latter type of incident. The choice is justified by the fact that incidents of this kind expose people to direct danger, especially that of smoke inhalation.

Analyse causes

Accident analysis based on our own data, that of foreign railways and the available literature was used to make a probability calculation. A distinction was drawn in the analysis between "major" and "minor" fires. The frequency distribution of the underlying causes was calculated for the "major" fires, which are relevant to this study.

Analyse effects

The way people behave in the event of fire largely determines whether or not the incident will develop into a disaster. An understanding of how people react in situations of this kind is thus very important. We took the existing literature as our basis for passenger behaviour. We looked specifically at flight behaviour, and particularly at how the layout of the tunnel contributes to this. The behaviour of railway personnel (movements inspector, guard, driver) and the emergency services was analysed using a variety of human factor techniques. A hierarchical task analysis, quantitative failure analysis and time-line analysis were then carried out. The hierarchical task analysis is the first step towards a quantitative approach to human error. The method breaks a functionary's task down into sub-tasks. The breakdown continues until we are left with concrete actions. This produces a clear description of the task. The quantitative failure analysis method is then used to determine what errors can be made when carrying out an action. The probability and consequences of error are then estimated. Account is taken, when calculating the probability of errors, of the conditions under which the task has to be carried out. It is clear from the outset that the pressure on railway personnel will increase in the event of a disaster, and so the probability of error will rise accordingly. In the time-line analysis, the actions that the different parties have to carry out are set out in terms of time. This allows potential conflicts in the task burden to be identified. A practical situation was used as an example to allow these analysis techniques to be applied. After all, the final system had not yet been designed. The idea underlying the analysis process was that its findings could be used to improve the design.

In addition to this data, it is also important to understand the process of smoke development. The engineering and architecture firms DHV and Holland Railconsult carried out an extensive literature study into this matter, which resulted in the formulation of a smoke model. This enabled us to draw certain conclusions regarding the time needed by passengers to escape.

Asses risks

A risk calculation was carried out for each tunnel design on the basis of cause analysis and estimated effects (Risk = Probability * Effect). As noted above, the overall risk of the HSL was examined. Account was taken of the following during the risk calculation:

- dimensions of the tunnel;
- safety facilities (escape routes, ventilation methods) of the kind imposed by Dutch building regulations;
- rail traffic data (frequency of use, capacity utilisation);
- control characteristics of emergency and safety systems.

The risk calculation focused on group risk - i.e. the likelihood of several people falling victim at once. The calculated risk was then compared to the standard set out in the NMP (National Environment Policy Plan). The risk approach set out in the plan establishes standards for group risk. It was used because of the absence of group risk standards for traffic systems.

Decision

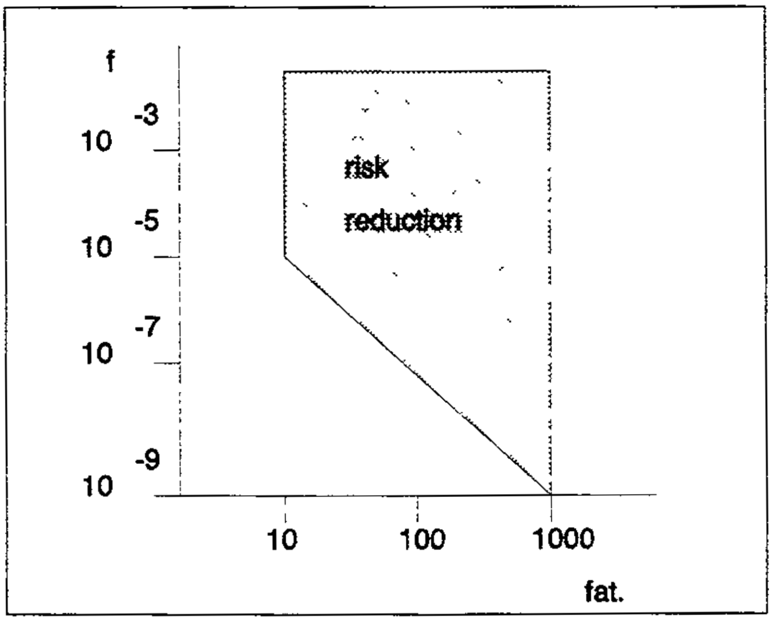
The results obtained from the previous stage allowed decisions to be formulated regarding the necessary measures for all the tunnel designs. These related not only to possible breaches of the standard, but also to measures which could have a substantial impact in reducing risk at a modest cost.

RESULTS

The likelihood of a "burning train" stopping in a 16 km-long tunnel was calculated at 1x in 100 years. That calculation does not, however, result in a profile of the risk exposure. To do that, we have to take account of the effects of fire. These are determined by a large number of variables:

- occupancy of the train;
- the position of the burning train in the tunnel;
- the type and scale of the fire when the train is stationary;
- smoke development and concentration.

Our own figures and data from foreign railway companies suggest that 1 in 10 of these situations would be serious enough to result in more than 10 victims. This calculation is based on a smoke movement model in a drilled tunnel with two single tracks made by specialists (DHV and Holland Railconsult). The likelihood of there being more than 20 casualties is thus 1x in 1,000 years. The graph below shows the NMP standard. This indicates that the calculated risk does not meet the standard. Additional measures are thus required.



Measures to reduce risk

Preventative measures are preferable when it comes to reducing risk. We mean by this that major fires on board trains should be avoided, as should the stopping of a burning train in a tunnel. The available measures in this regard relate to the effective and prompt detection of the fire, and the facilitation of an adequate response should such a situation arise. Another example is the risk-reducing effect of facilities on board the rolling stock, such as emergency brake override and extinguisher systems. It is estimated that these two measures would reduce the likelihood of the incident by a factor of 0.1 each. This gives a probability for a burning train stopping in a tunnel of 1x in 100,000 years, a level of risk that falls within the NMP standard.

Further risk reduction can then be sought via the ALARP principle. This entails studying whether the risk can be further reduced at modest cost.

The results produced by the application of human factor techniques illustrate the risk-reducing potential of certain measures. It was established, for instance, that there would not be sufficient time for the signalman, drivers, guards and personnel of the Incident Room to implement all the actions required by a disaster plan. It was also found that the consequences of errors made by these individuals would have a direct impact on passengers' escape time, significantly raising the level of risk. There are numerous measures that can reduce the likelihood of human error. It was proposed, for instance, that several actions be carried out automatically on the basis of train stop detection:

- signalman and Incident Room notified:
- train movements on adjacent track stopped immediately - if necessary, a train on the adjacent track may be stopped in the tunnel (if there two separate tunnels);
- emergency doors opened automatically;
- information on escape routes and the unlocking of emergency doors should be provided.

It is noteworthy that the cost of these measures is significantly lower than that of those that are generally used, such as ventilation techniques, extinguishing techniques, the use of additional emergency doors, and so on. Expressing the different measures in terms of the available escape time for passengers, allows the risk-reducing effect to be weighed effectively against the cost. The failure analysis also established that measures designed to assist the passengers' self-preservation instinct were more effective than the actions of the emergency services. It should thus be made as simple as possible for passengers to escape. Therefore, hand-rails, escape route signs and directional emergency lighting ought all to be designed from an ergonomic point of view.

CONCLUSION

There are, of course, major benefits to be obtained by applying integrated risk and failure analysis methodology. The effectiveness of risk-reducing measures in particular can be better calculated using human factor techniques. The idea underlying this approach is recognition that human failure often plays a decisive role in the occurrence of accidents. This study has shown that an approach based on human factors can save a great deal of expense when laying out and building the tunnel. A saving of between 20 and 30 million guilders can be achieved for several of the tunnel designs. It would appear a great deal more effective to use relatively cheap measures that respond to human behaviour than to resort to expensive constructional measures. An essential aspect of this approach is that specialists in the field of human factors and risk analysis should be brought into the project at an early stage, and allowed to continue their input during the specification and design stages.

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Mike Darby

Alertness Assurance Programme Reducing Fatigue and Increasing Alertness in Canadian Railways

Publisher
2000 International Rail Safety Conference

II/1 **Mike Darby**

Alertness Assurance Programm: reducing fatigue and increasing alertness in Canadian Railways

Canadian Railway Employee Alertness Program

Presentation to:

International Railway Safety Seminar

October 10, 1995
Mainz, Germany

History

- Transport Canada (TC) is Canadian Regulator
- prior to Hinton Disaster (1986) <u>no</u> Mandatory Rest/Maximum Time on Duty Regulations
- operating crews relied on Collective Agreement Rest
- 1988 Mandatory Rest Regulations Imposed
  - » 8 hrs rest after 10 hours on duty
- 1993 TC imposed Maximum on Duty Times
  - » 12 hours/max 18 in 24 hours
- TC not satisfied and imposed 18 month time frame to develop new regulations (by July 1, 1995)
- BLE/CN/CP/VIA/UTU set up Task Force

Canadian Railway Employee Alertness Program

Circadian Technologies Inc. (CTI)

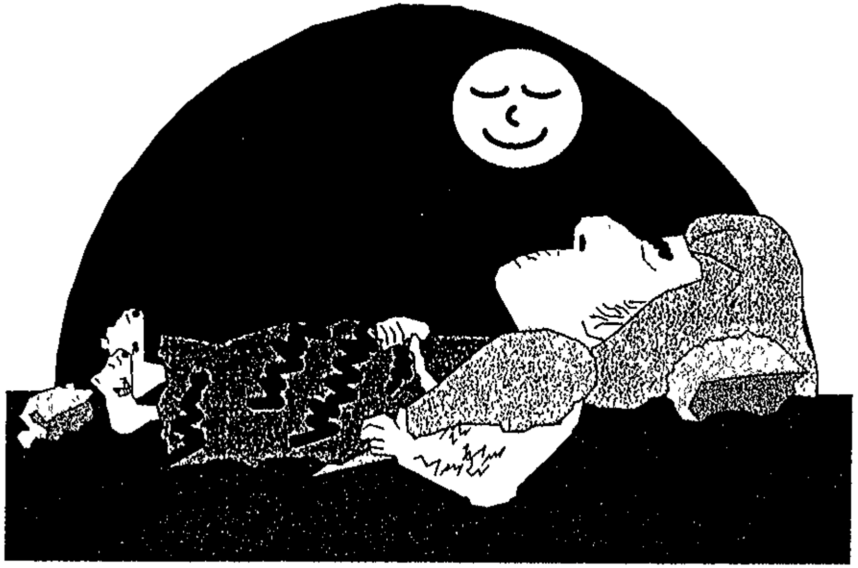
- Union/Management Task force stalled and required assistance with complex alertness/rest issues

- US DOT recommended Dr. Martin Moore-Ede
  - » Harvard Professor & Pioneer in Alertness Physiology

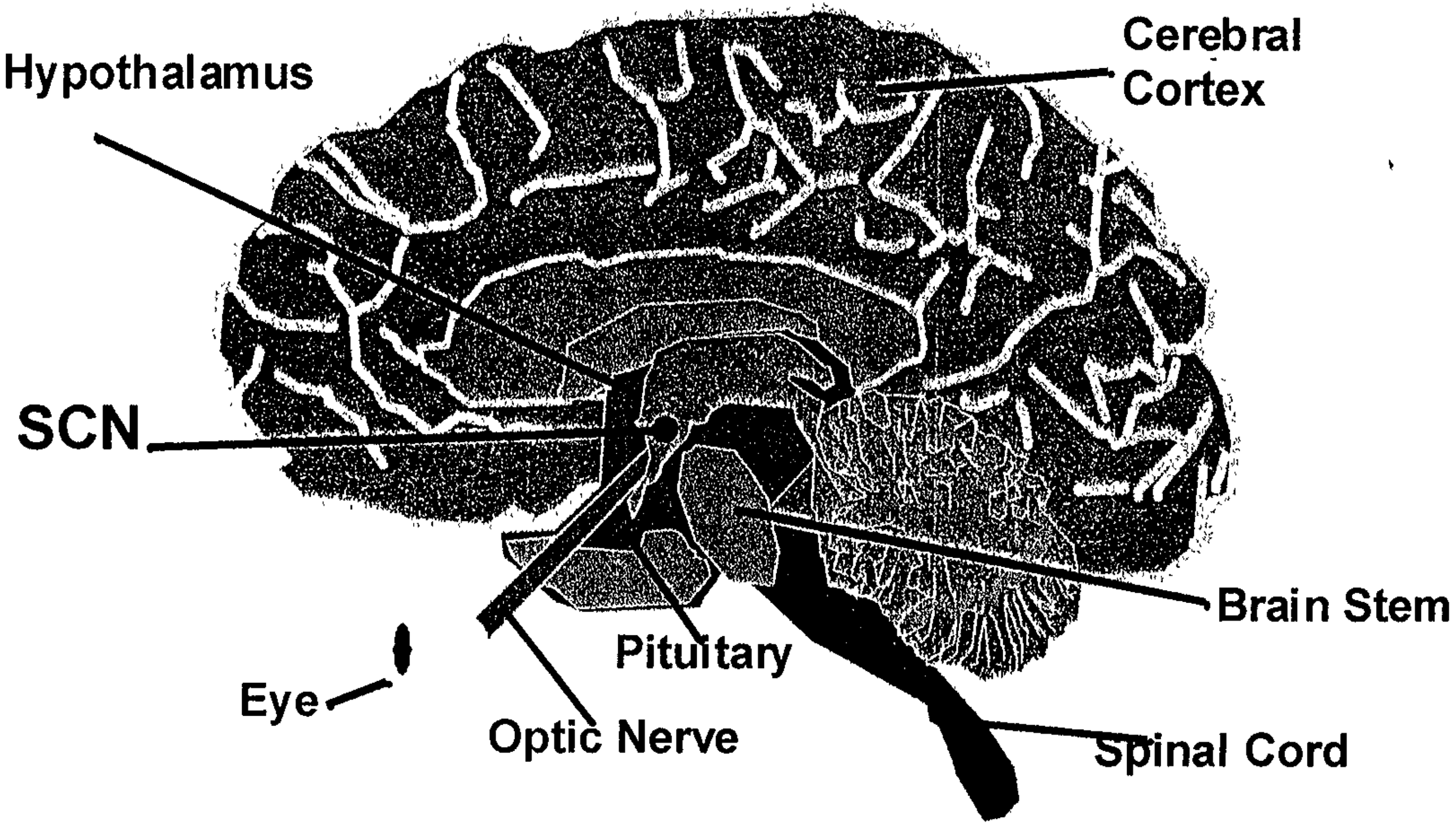
- CTI Developed Program
  - » Pilots in Calgary (CP) /Jasper (CN) /Montreal(VIA)
  - » Project measured fatigue levels in May 95
  - » Implement fatigue countermeasures
  - » Measure fatigue levels in September 95
  - » Assess Recommendations

Design Specs of the Human Body

Humans were not designed for sustained vigilance at night.

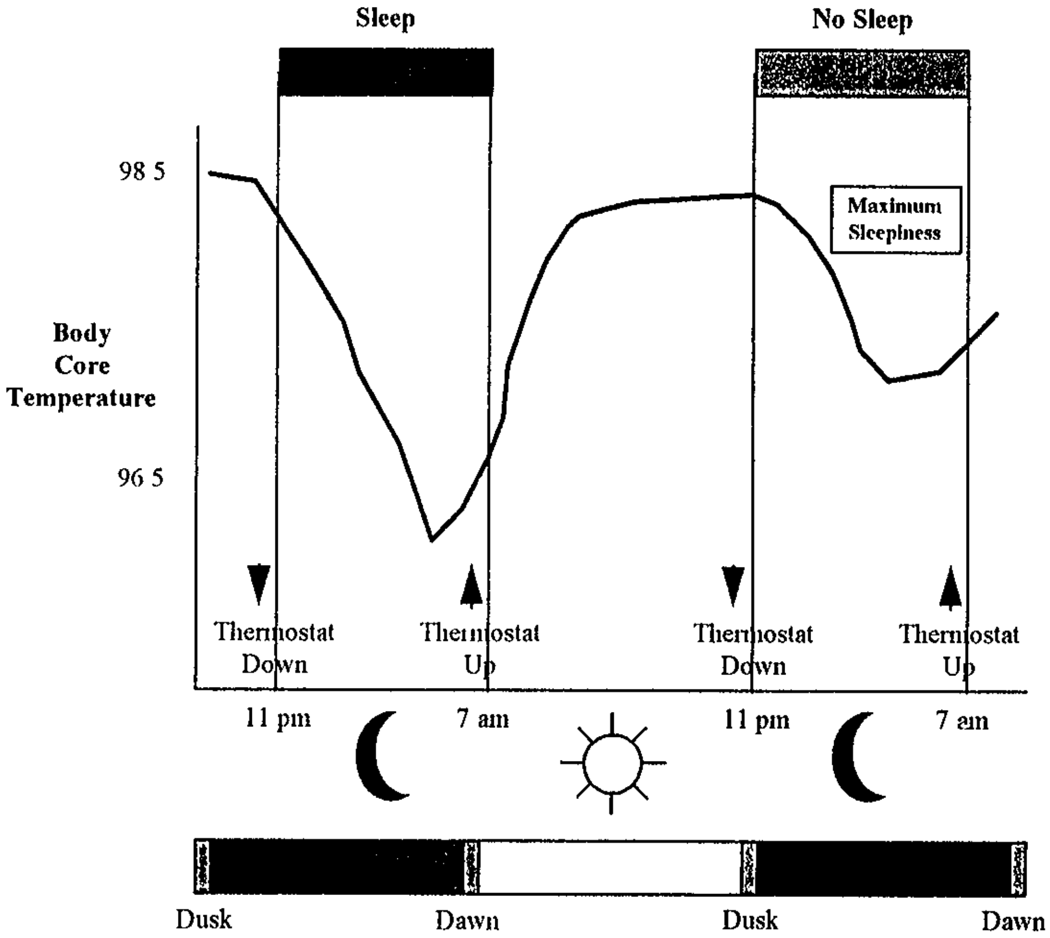


Location of Biological Clock Suprachiasmatic Nucleus (SCN)



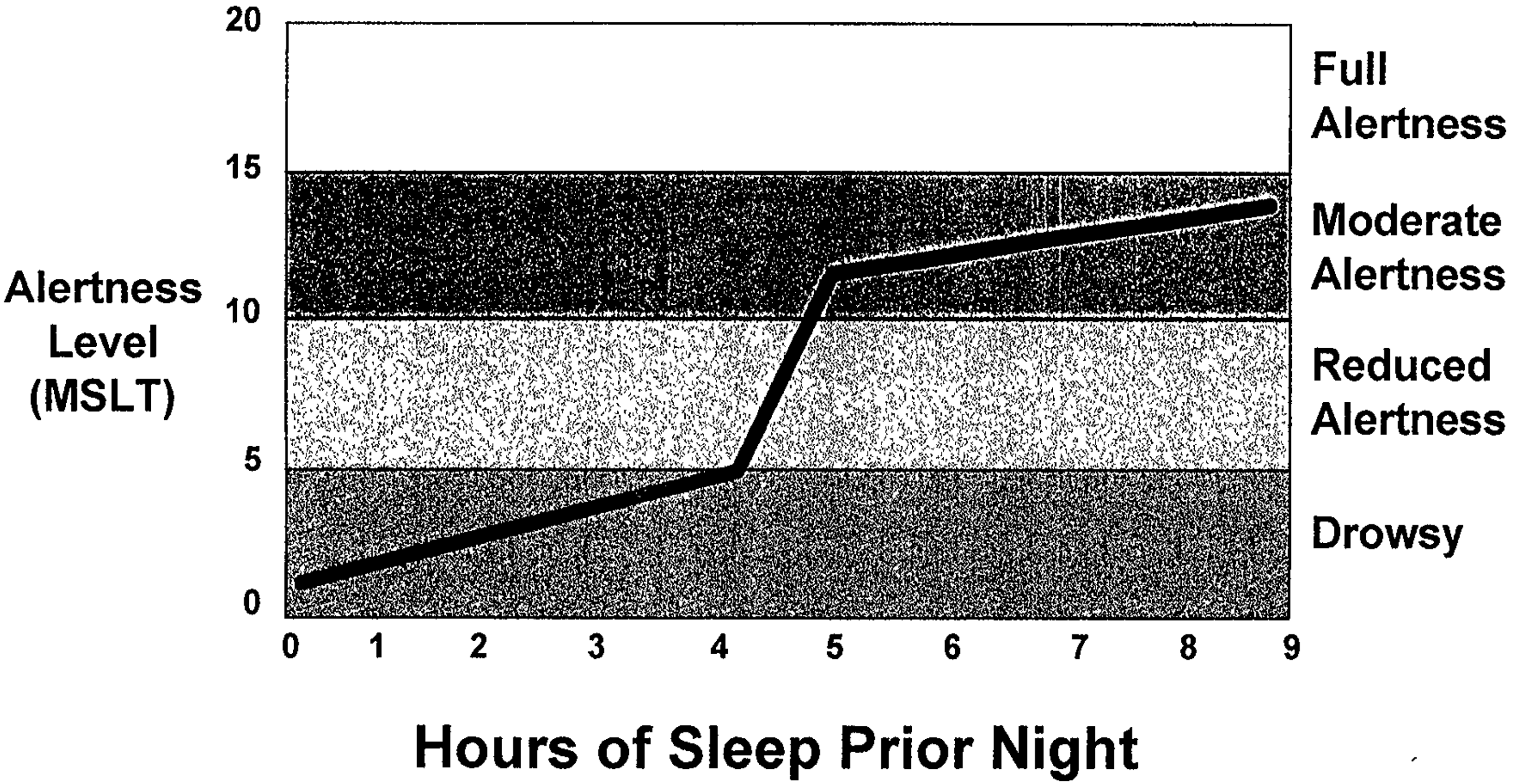
Source: Circadian Technologies, Inc. (1993)

Circadian Temperature Rhythms

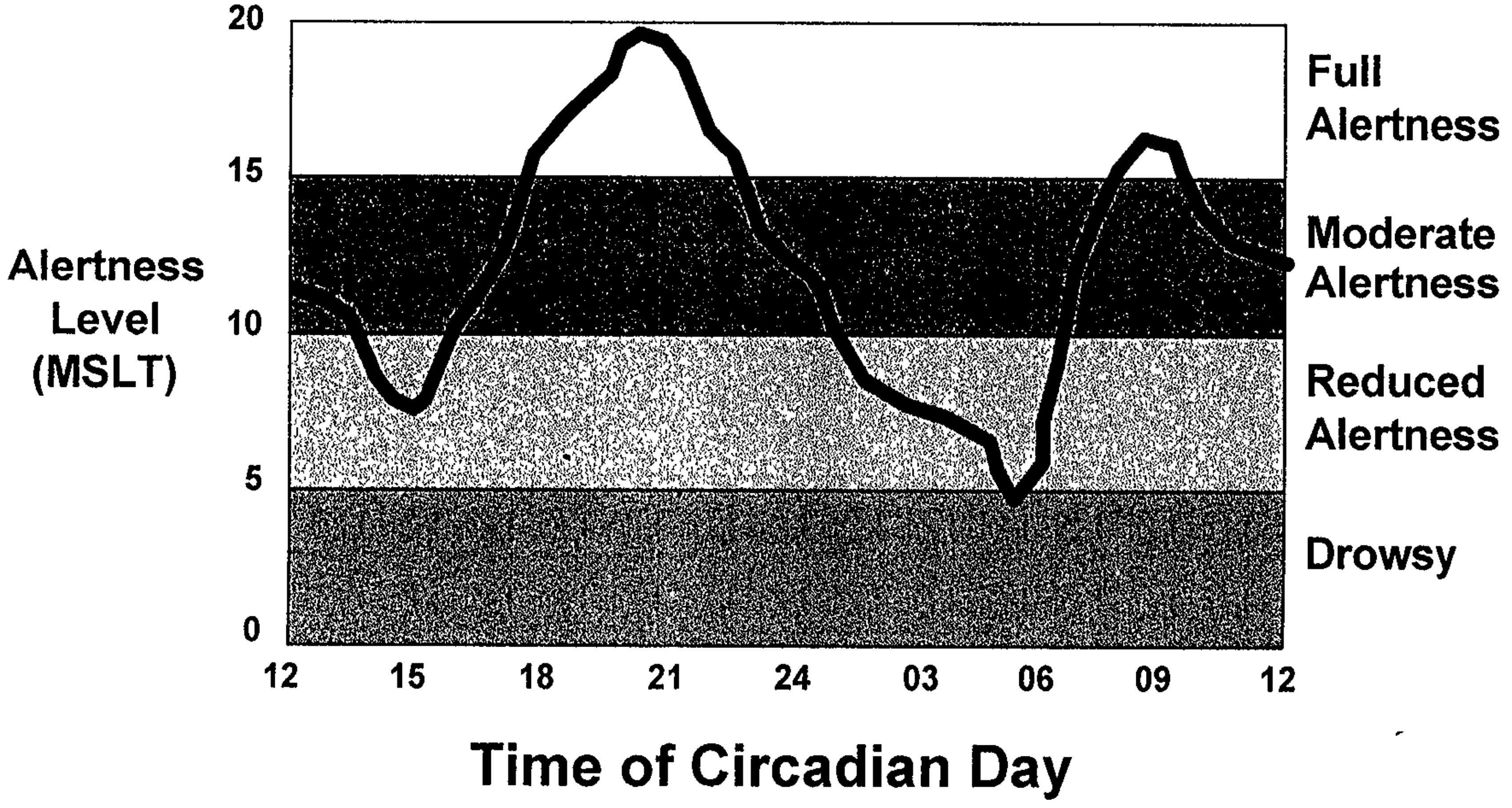


Whether we are awake or asleep, body functions continue to follow their Circadian rhythms.

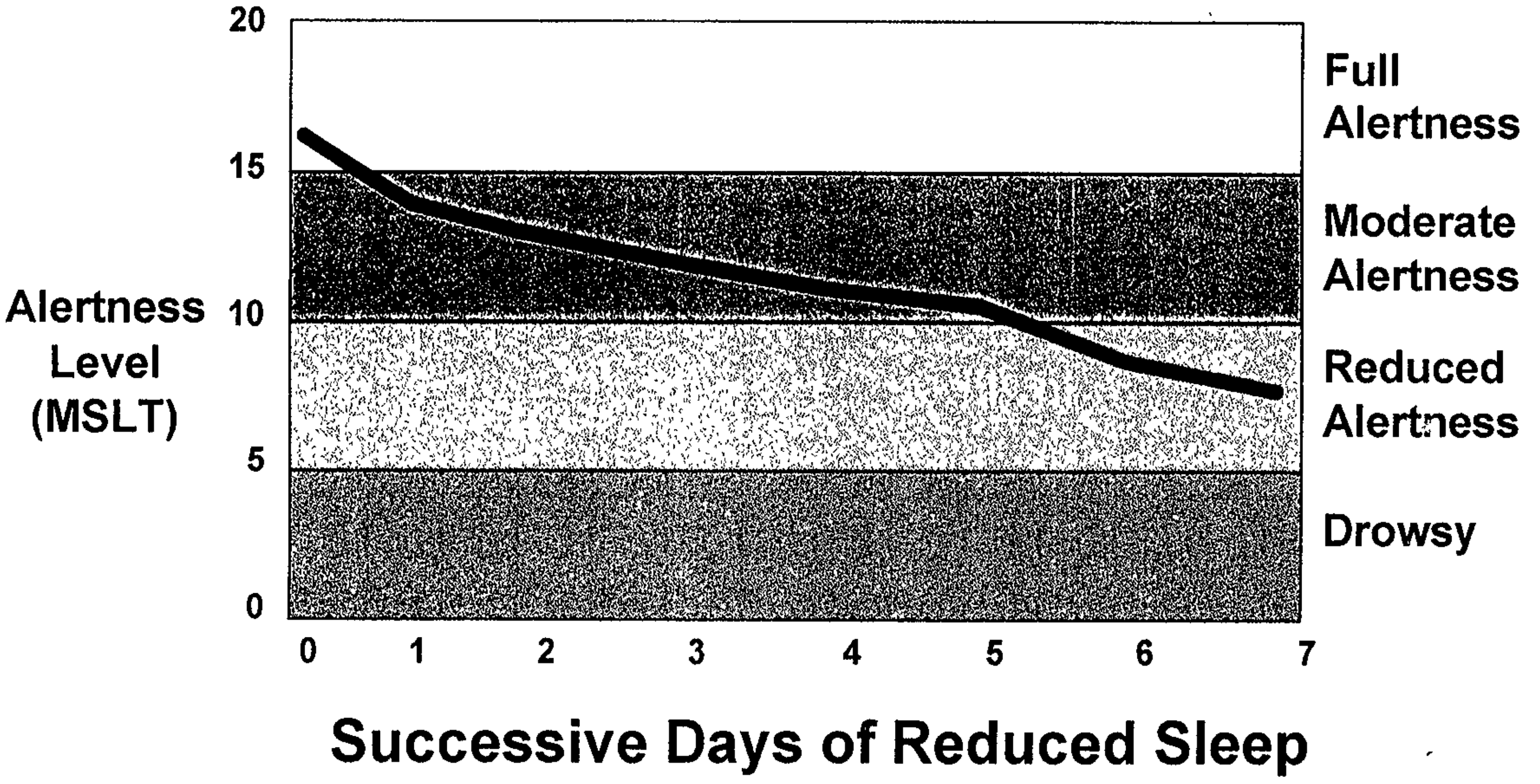
Determinants of Human Alertness



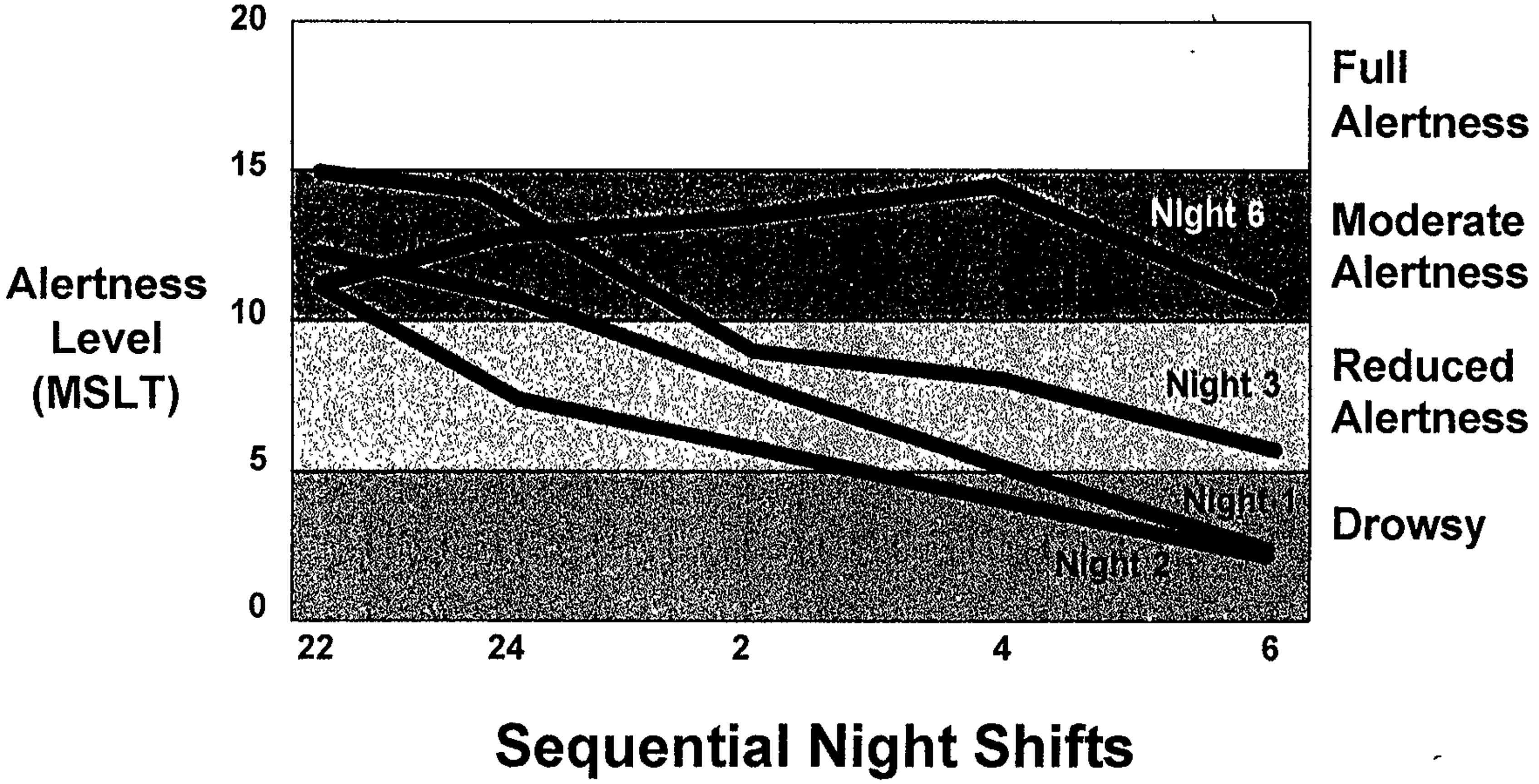
Determinants of Human Alertness



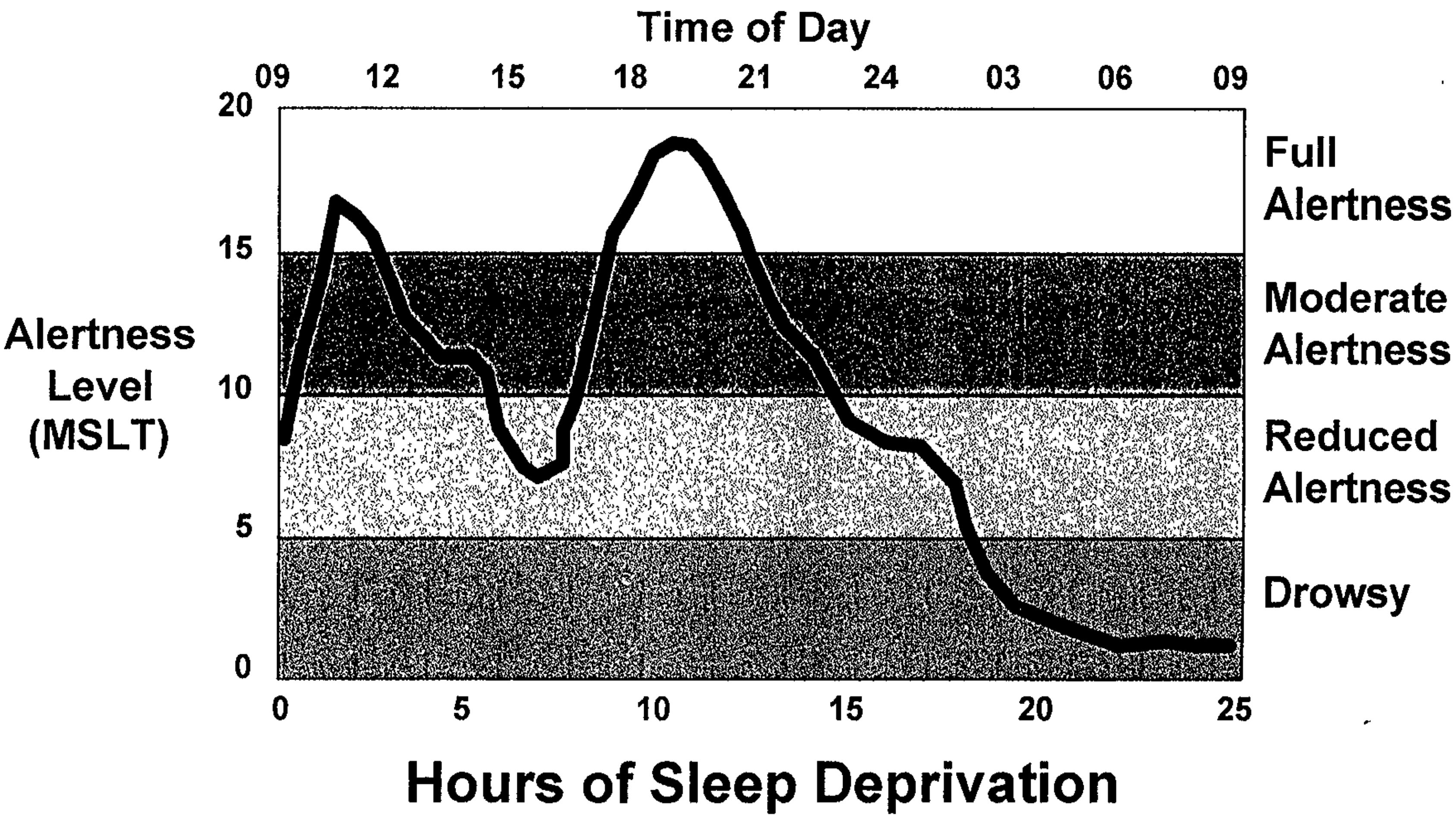
Determinants of Human Alertness



Determinants of Human Alertness

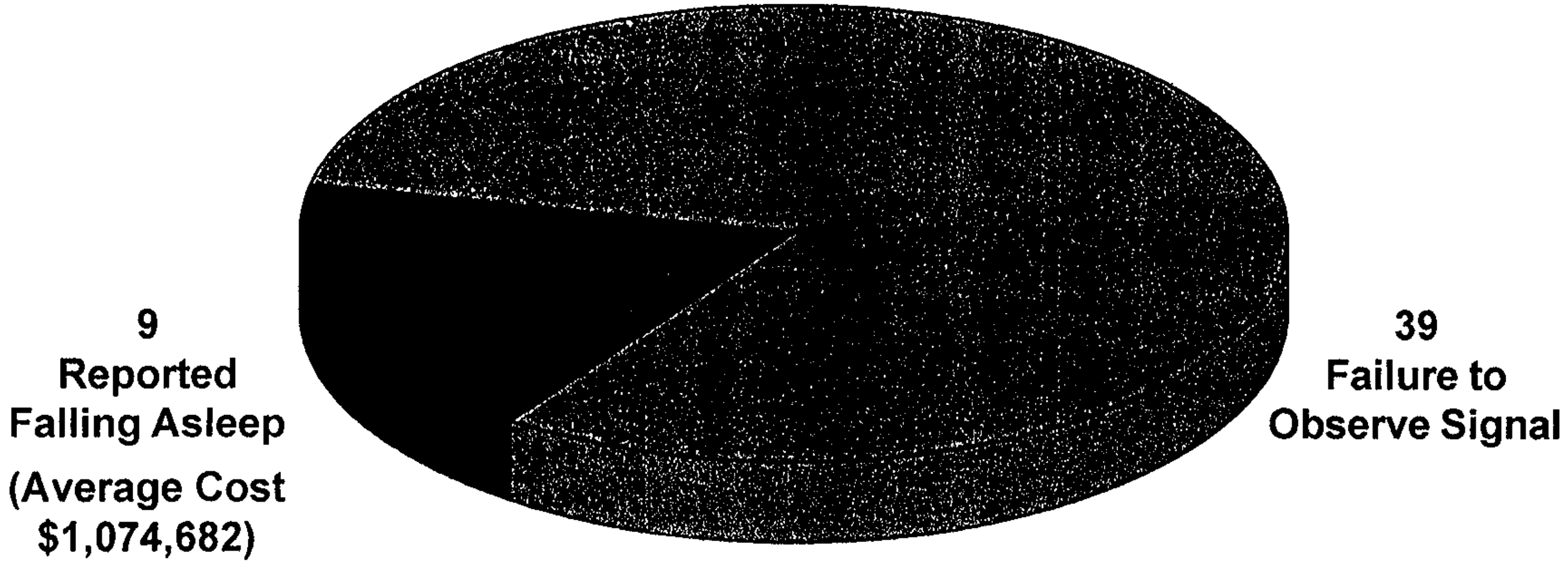


Determinants of Human Alertness



U.S. Railroad Accidents Related to Fatigue

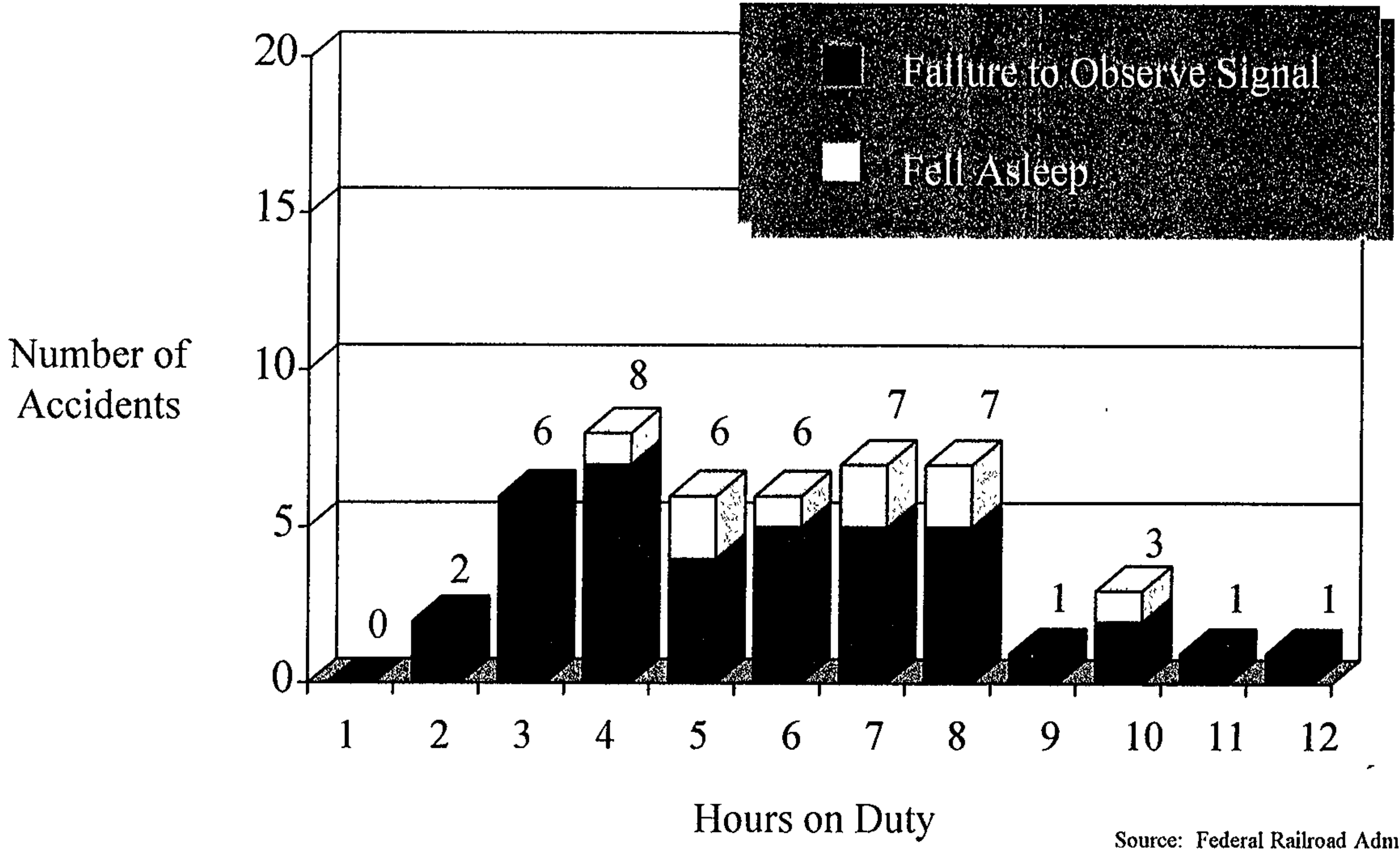
(1989-1991)



Total = 48

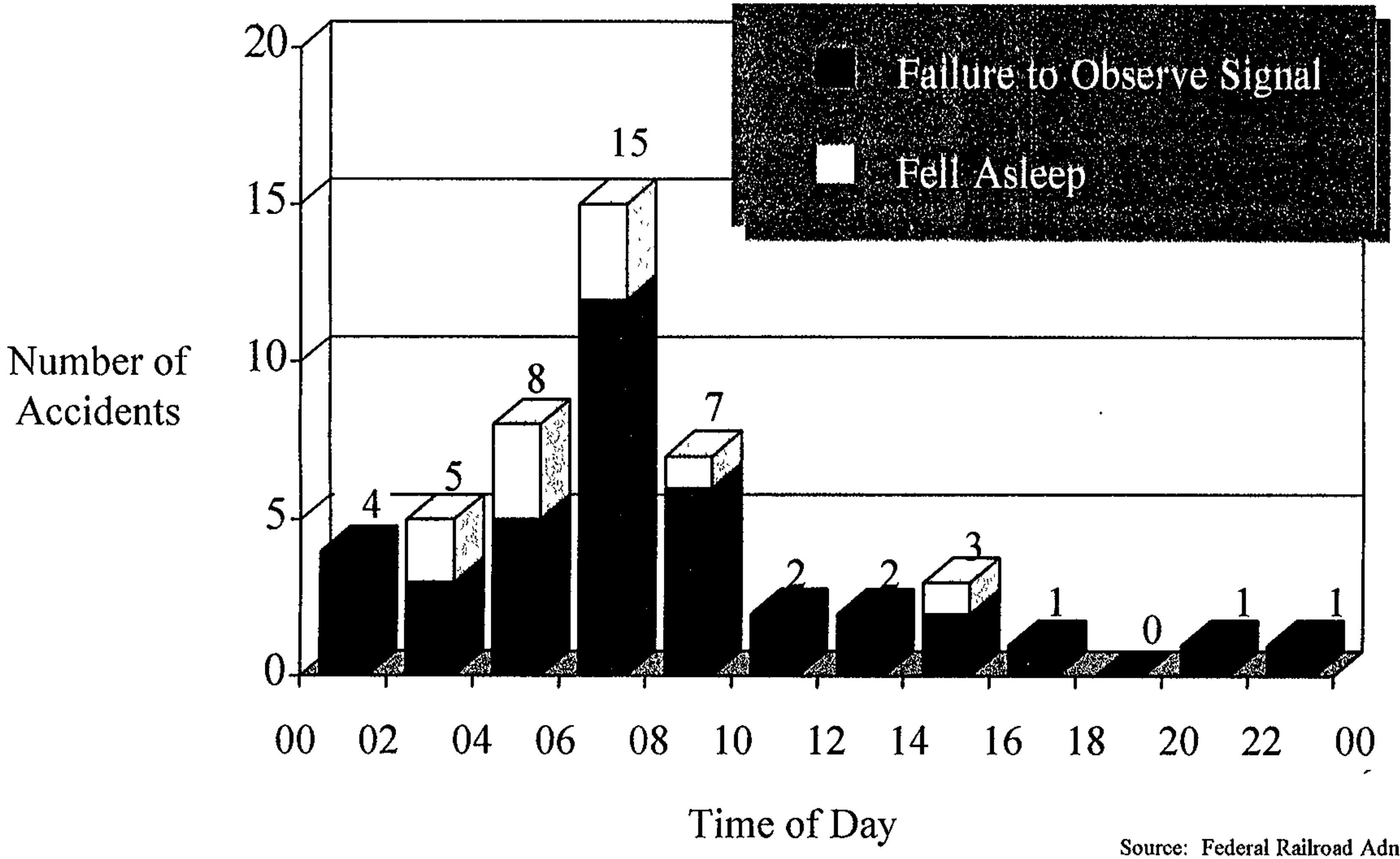
Source: Federal Railroad Administration
1989-1991

U.S. Railroad Accidents by Hours on Duty



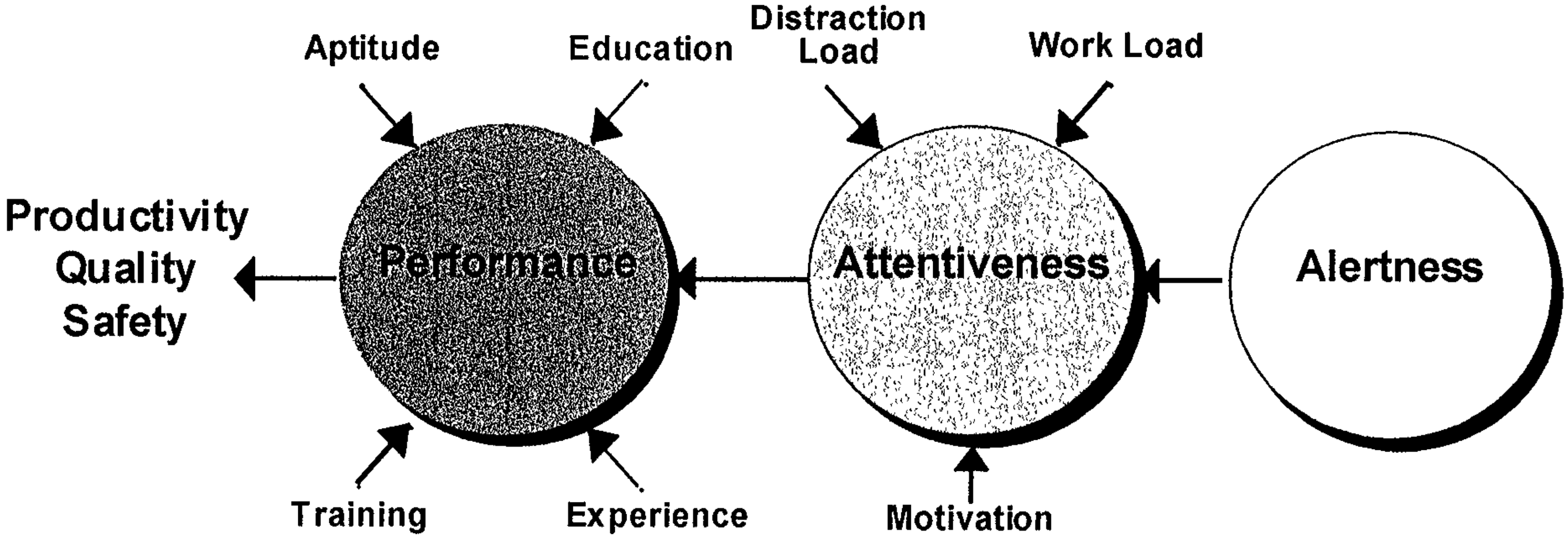
Source: Federal Railroad Administration
1989-1991

U.S. Railroad Accidents by Time of Day



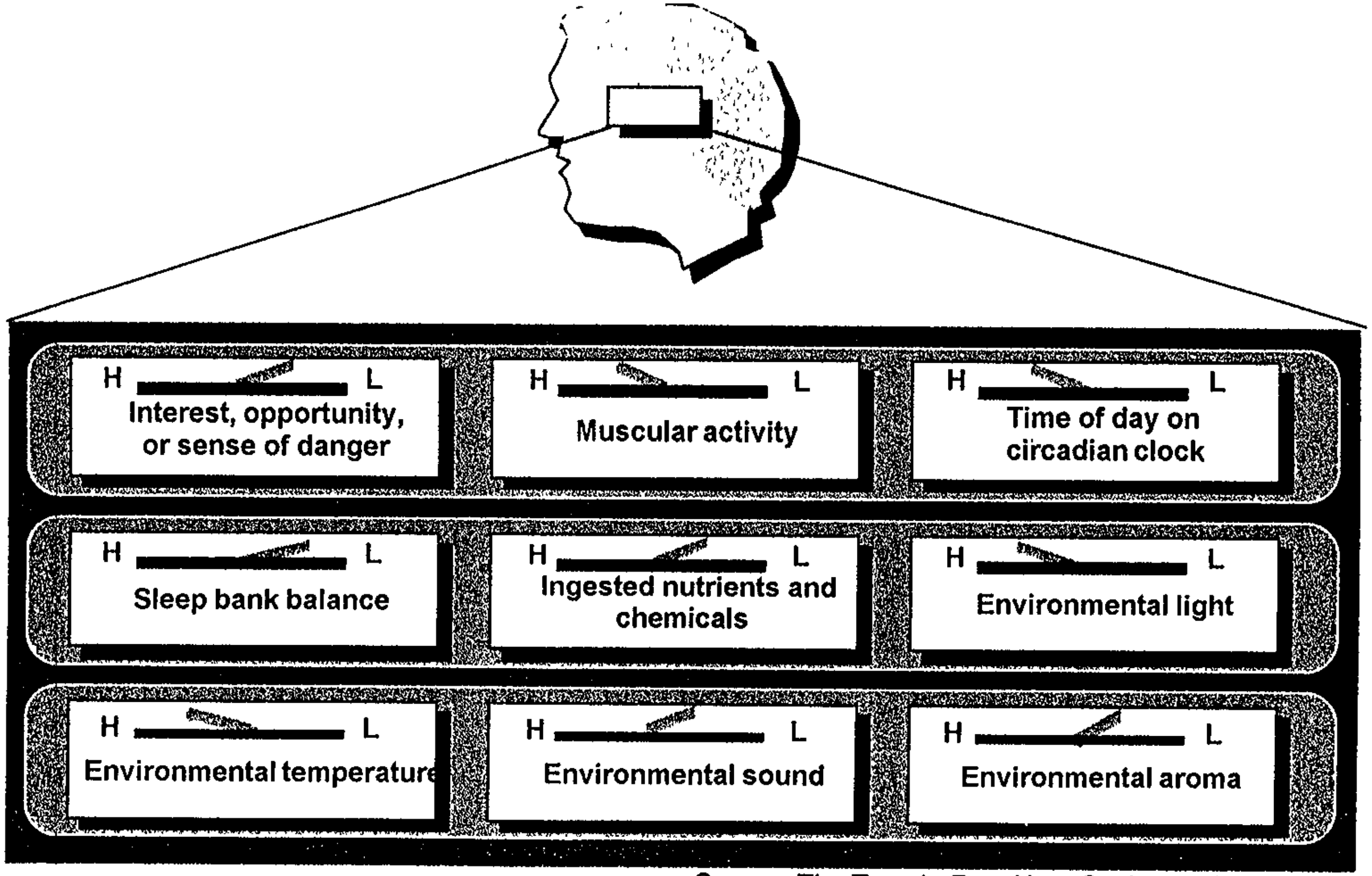
Source: Federal Railroad Administration
1989-1991

Performance/Attentiveness/Alertness



Source: The Twenty Four Hour Society (1993)

The Nine Switches of Human Alertness



H L

Interest, opportunity, or sense of danger

H L

Muscular activity

H L

Time of day on circadian clock

H L

Sleep bank balance

H L

Ingested nutrients and chemicals

H L

Environmental light

H L

Environmental temperatur

H L

Environmental sound

H L

Environmental aroma

Source: The Twenty-Four Hour Society, Addison-Wesley

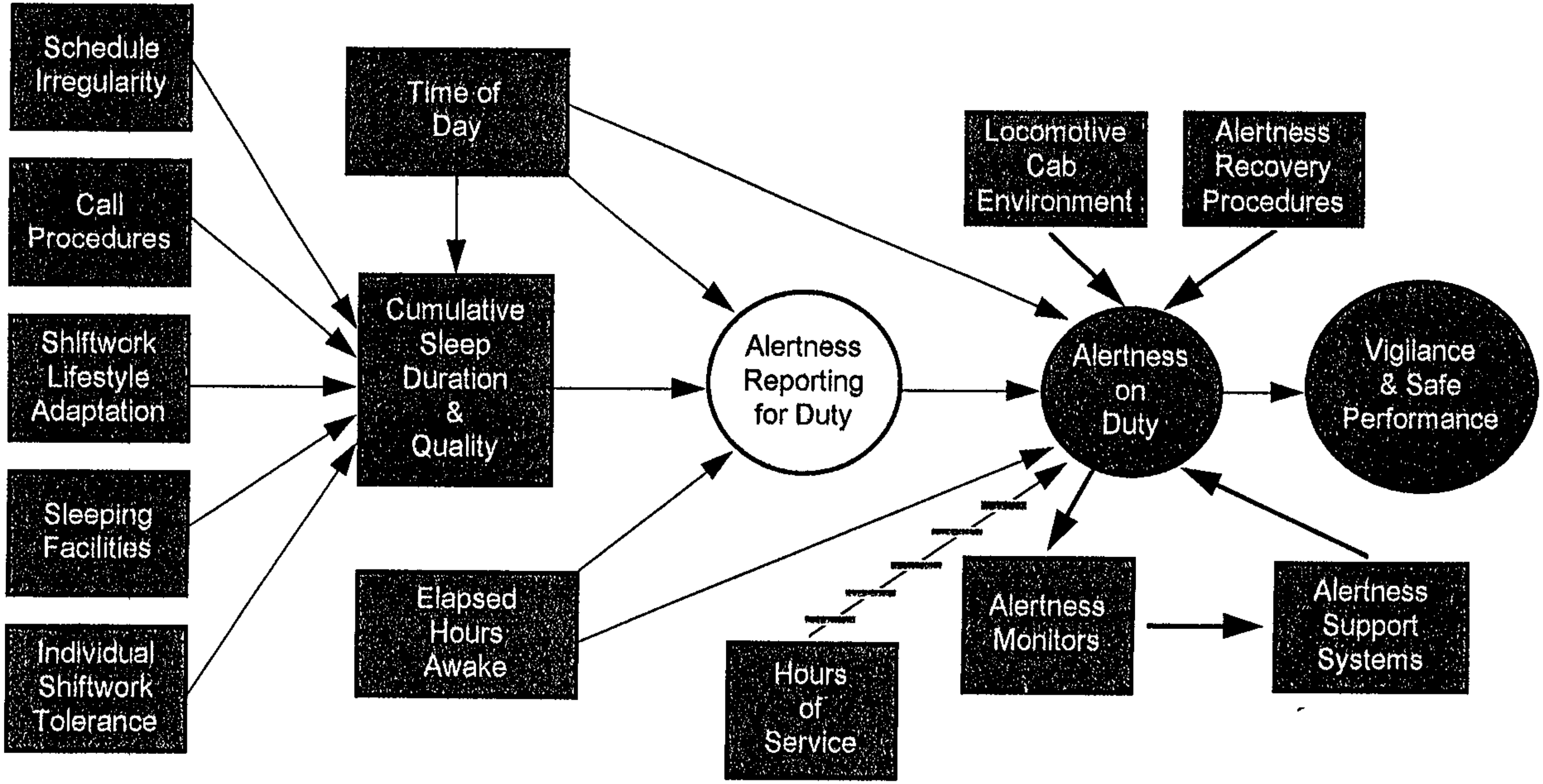
Current Hours of Service Regulations

- **Are based on faulty intuition**
  - Number of consecutive hours on duty is not the best predictor of dangerous levels of fatigue
  - Night does not equal day

- **Lower railroad efficiency without significantly reducing risk of fatigue & loss of alertness**

- **May promote the use of schedules which disrupt sleep and increase cumulative fatigue**

Determinants of On-Duty Alertness & Performance in Railroad Employees



Schedule Irregularity

Call Procedures

Shiftwork Lifestyle Adaptation

Sleeping Facilities

Individual Shiftwork Tolerance

Time of Day

Cumulative Sleep Duration & Quality

Elapsed Hours Awake

Alertness Reporting for Duty

Hours of Service

Locomotive Cab Environment

Alertness Recovery Procedures

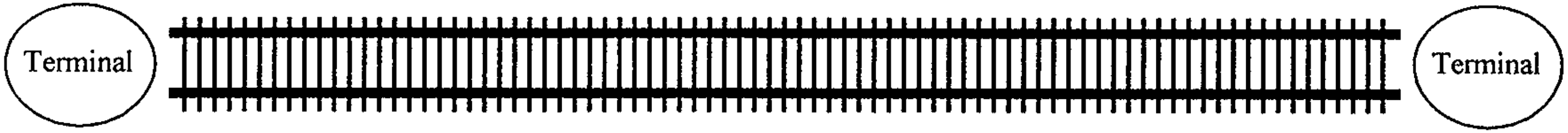
Alertness on Duty

Alertness Monitors

Alertness Support Systems

Vigilance & Safe Performance

Establish a Test Track for Trials of Fatigue Countermeasures



- Requires on-duty times of 8-12 hours
- Frequently travelled 24 hours/day
- Sufficient pool of operating employees available to tes. in both directions
- Representative in terms of schedule irregularity, delays, fatigue risk
- Convenient test sites at terminal at each end
- Accessible location for project team

Alertness Survey of Alberta Railway Engineers

- **Although only 13% have had actual incidents, errors or injuries on the job, 35% have had 3 or more near incidents in the past year**
- **18% have had 3 or more near automobile accidents in the past year**
- **26% of accidents or injuries due to fatigue or lack of alertness**
- **60% frequently use stimulants to help stay awake and mentally alert**
- **16% feel alertness is impaired once or more per run to the point where they are not mentally effective while working on their current schedule**
- **85% feel the need for increased alertness on the job**

Alertness Survey (continued)

- 72% state that their schedule is making them overly tired or fatigued
- 73% report that this state of fatigue makes them feel drowsy while working
- 72% consider their job to be mentally demanding
- 73% consider their job to be stressful (32% become irritable more than several times per week on the job)
- 82% consider their job to be "very highly" or "highly" fatiguing

Alertness Survey (continued)

- **Fully 92% report that they have been awakened by the RSC Device**
- **89% have thought they have missed an advance signal but actually had not (29% report this had happened "sometimes" in the past year)**
- **35% report being "sometimes" fatigued to the point that they drift into sleep while running the train (10% report this to be a frequent occurrence)**
- **63% have booked unfit due to fatigue in the past year**
- **50% have booked sick due to fatigue in the past year**

Alertness Survey (continued)

- 59% report that most "fighting sleep" periods experienced "at dawn, just as the sun is coming up"
- 98% take naps if in a siding at the time of a "fighting sleep" period
  (60% do so "frequently")
- Most engineers wake up from the sound of an approaching train or due to radio communication of an approaching train
- 91% believe that their quality of rest would improve significantly if ALLOWED to take a nap

Participants in Fatigue Countermeasure Study

- Running Trades Employees (engineers) performing regular duties
- Volunteers only (20 per test group)
- Representative cross-sample of employees
- All individual reports, results and data kept strictly confidential by CTI
- Only group data reported back to Steering Committee, CN, CP, VIA, & BLE and Transport Canada
- Minimal interference with regular duties, schedules, and personal life

Fatigue Countermeasure Study Freight Operations

- Test effect of countermeasures on alertness
- Calgary CP / Jasper CN
- 40 volunteers
- Study Design
  - base line testing
  - countermeasure implementation
  - re-testing
- Test Measurements
  - 3 round trip wire-ups per test period
  - measure EEG, activity monitoring, sleep logs etc.
- Report to be issued February 29, 1996

Fatigue Countermeasure Study Passenger Operations

- Test the effects of high speed operations
- VIA Quebec City
- 10 volunteers selected for study
- Study Design
  - 2 round trip wire-ups
  - measure EKG, Heart Rate Variability & Micro-Sleep
  - Pre/Post Run Tests
  - Ativity monitoring
  - CAS Simulations
- Results compared to freight study
- Test period August 9-August 23

STUDY DESIGN AND CONCEPTS

- Two test tracks:
  - Calgary to Field
  - Jasper to Blue River
- 20 volunteers for each test track
- Before (baseline) and after (evaluation) study
- Baseline: May 1995
- Evaluation: September 1995
- EEG data collection: Three random samples on non-consecutive days
- Baseline:
  - No countermeasures
  - No changes in current organization
  - No naps

Fatigue Countermeasure Plan
Implementation Phase

- Identify from pilot phase most effective countermeasures
- Study feasibility and costs of systemwide implementation
- Develop detailed implementation plan

Project Objectives

To develop, validate and implement a set of fatigue countermeasures (technologies, rules, procedures and practices) which will ensure that:

1. Employees commencing duty are rested and alert
2. Alertness is sustained throughout the duty period

and to the extent that is consistent with 1 & 2

3. Permit employees to meet their personal needs
4. Enable the railroads to meet service objectives and implement change

Measures of Alertness

Subjective Measures

- Sleep & alertness survey
- Daily Alertness Logs
- Mood scale
- Visual Analog Scale of Alertness

Objective Measures

- Actigraph Monitoring
- EEG monitoring
- Occular Motor Test
- Alpha Attenuation Test

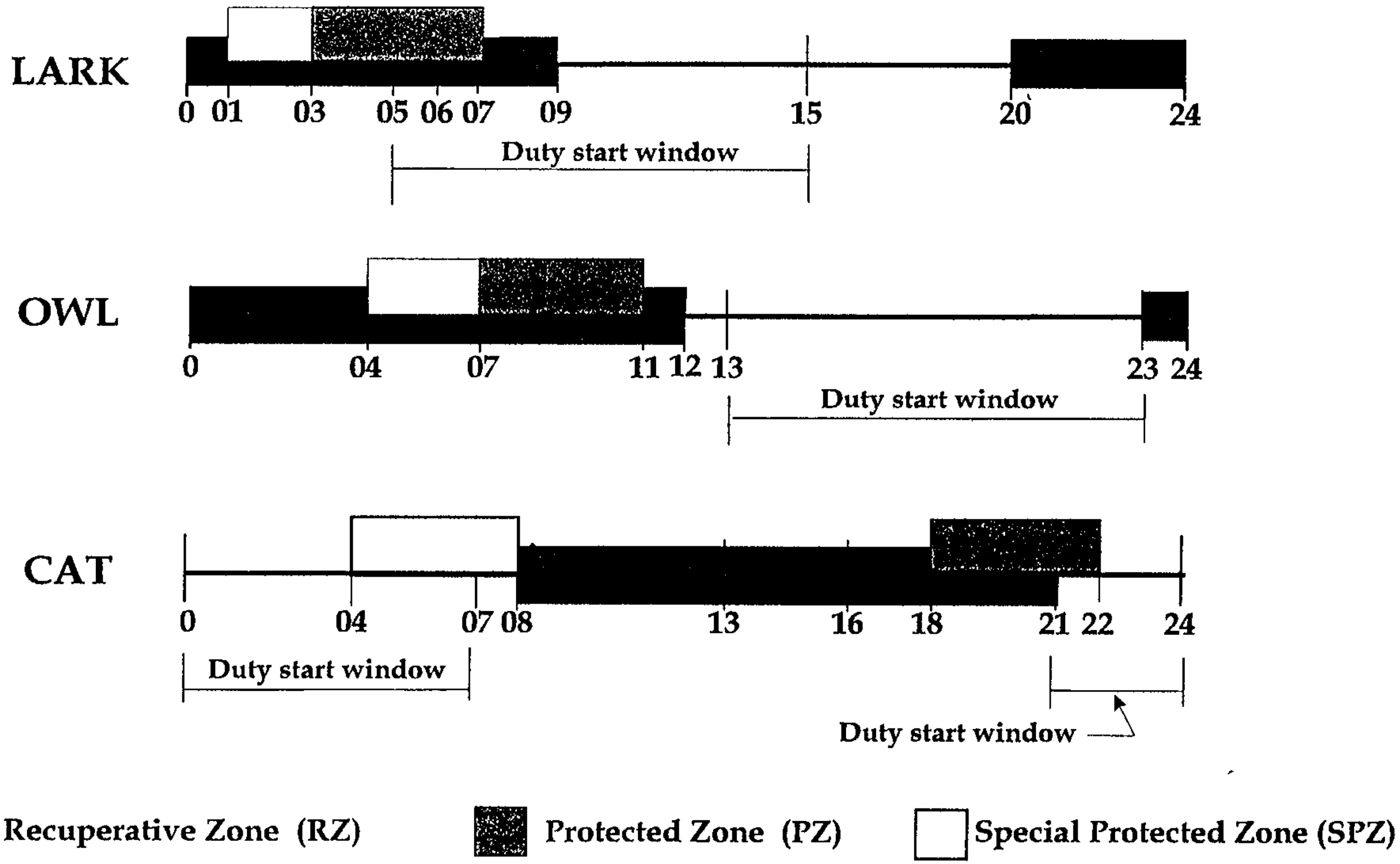
Performance Measures

- Event Recorder Analysis

Countermeasures

- Improve schedule regularity by creating a time pool system and addressing crew management procedures
- Improve sleeping facilities by either replacing bunkhouses with hotels or by improving bunkhouses
- Develop policy of napping in meets/sidings with appropriate safety procedures. Develop napping On-Duty Pre-Run where possible
- Provide training program on railway shift lifestyle
- Identify people with sleep disorders
- Test feasible improvements to locomotive cab to improve alertness, reduce stress/fatigue

Time Pools


LARK
0 01 03 05 06 07 09 15 20 24
Duty start window
OWL
0 04 07 11 12 13 23 24
Duty start window
CAT
0 04 07 08 13 16 18 21 22 24
Duty start window
Duty start window
Recuperative Zone (RZ)
Protected Zone (PZ)
Special Protected Zone (SPZ)

Napping Strategy

- Engineer will advise frequency change to RTC
- Change to quiet frequency
- Train crew will verify frequency change
- Napping available to all crew members
- Rule 110 Relief (Train Inspection)
- Wake-up timers to be provided
- Total nap window: 35 minutes (Approx.. 20 min. sleep)
- Blindfolds to be provided at home terminal

(More)

Napping Strategy (continued)

- Engineers will secure train prior to nap
- Napping OK on mainline with RTC approval
- RTC will call if train does not depart after clear signal or if stopped on mainline with no signal
- Napping facility provided at home terminal

Cab Improvements

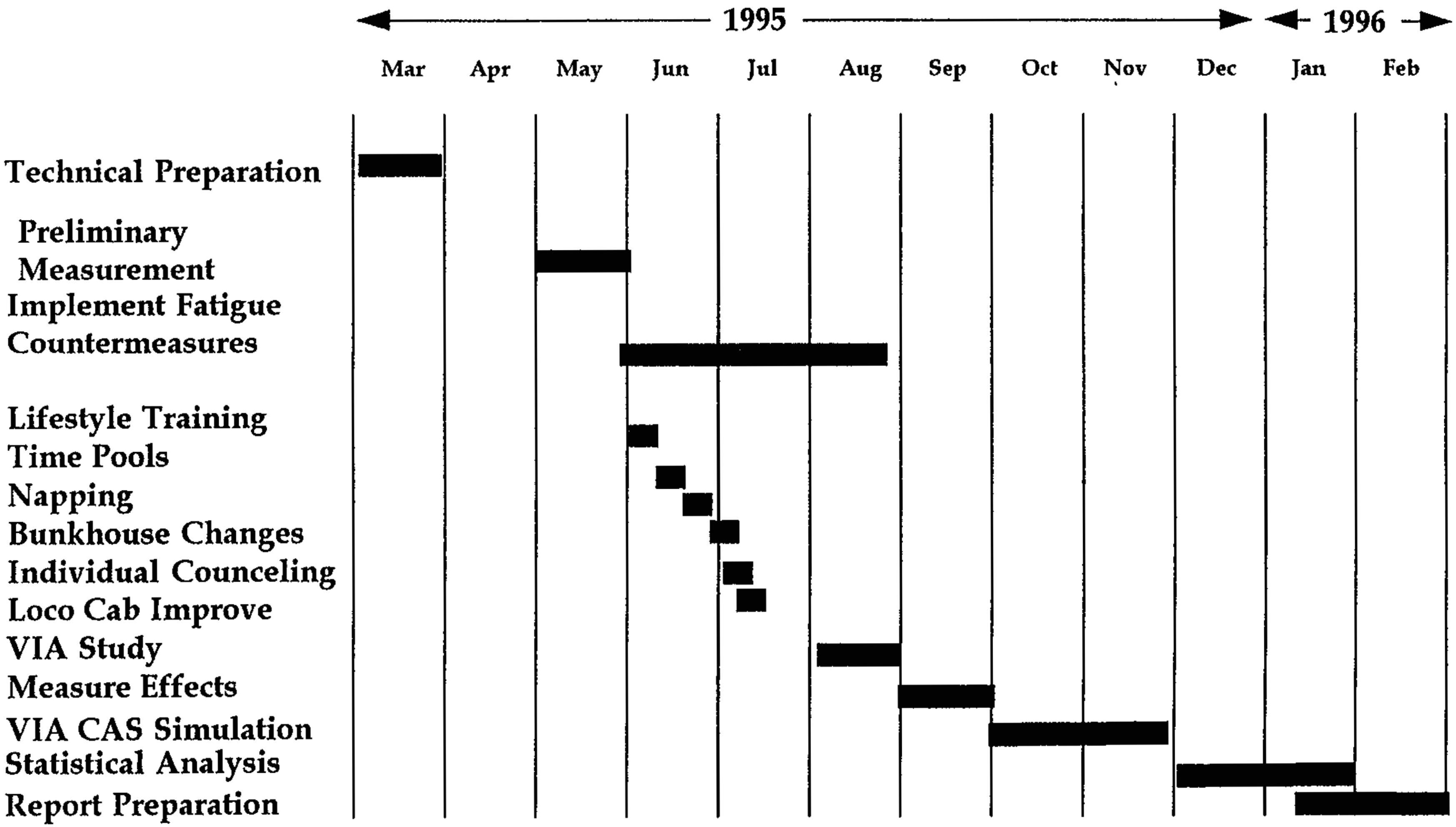
Test Headsets/Intercoms

- **David Clark Headsets**
- **Portable Intercom System between Engineer and Conductor**
- **Tape Players**

Counseling/Lifestyle training

- Individual counseling
- Train Participants in Railway Lifestyle Training (includes families of locomotive engineers)

CANALERT Project Timeline



Progress to date

- Full cooperation from locomotive engineers / Brotherhood of Locomotive Engineers
- Major contribution of B of LE to study design
- Many more volunteers than required
- 118 return trip EEG recordings
- Laboratory quality recordings
- Met all subjective/objective measurements
- All countermeasures implemented
- 2 drop outs from Calgary
- All volunteers back in assigned time pools

Alertness Assurance Program

A cooperative (win-win-win) effort between management, BLE and regulators to reduce employee fatigue and its costs for railroads and their employees

- Increased safety and operational performance of railroad
- Improved working conditions, lifestyle and health for employees
- More rational approach to FRA/TC safety oversight responsibility

International Rail
Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9507

Kevin Band

Personal Stress and its Affect upon Railways

Publisher
2000 International Rail Safety Conference

II/2 Kevin Band

Personal Stress and its Affect upon Railways

SUBJECT HEADING: HUMAN FACTORS

TITLE OF PAPER: PERSONAL STRESS AND ITS AFFECT UPON RAILWAYS

SPEAKER: KEVIN BAND, HEAD OF SAFETY POLICY, BRITISH RAIL

GOOD MORNING LADIES AND GENTLEMEN.

THANK YOU FOR THE OPPORTUNITY TO TALK TO YOU ABOUT PERSONAL STRESS. SOME OF YOU MAY ASK "WHY, WITH ALL THE AVAILABLE SUBJECTS TO TALK ABOUT, SHOULD I CHOOSE STRESS". I BELIEVE THERE ARE THREE MAIN REASONS.

FIRSTLY, LADIES AND GENTLEMEN, I PASSIONATELY BELIEVE THAT PEOPLE ARE OUR MOST VALUABLE ASSET. AN ASSET THAT FOR MANY YEARS HAS BEEN NEGLECTED. RAILWAYS SPEND VAST AMOUNTS OF MONEY ON TRACK, RESIGNALLING AND TRAINS, AND YET THE MOST COMPLEX PART OF THE RAILWAY SYSTEM IS THE BRAIN OR MIND OF OUR OPERATORS, PARTICULARLY SAFETY CRITICAL STAFF, DRIVERS AND SIGNALMEN ETC..

IF WE VALUE OUR PEOPLE, WE SHOULD CONSIDER ALL ASPECTS THAT EFFECT THEM. WE CONSIDER PHYSICAL WELL-BEING, WE WOULD NOT ALLOW A DRIVER TO DRIVE A TRAIN WITH A BROKEN ARM HOWEVER, HOW MUCH THOUGHT DO WE GIVE TO THEIR STATE OF MIND?

SECONDLY, I BELIEVE THE RAILWAY ENVIRONMENT TO BE UNIQUE FROM MANY OTHER PLACES OF WORK. IN A FACTORY OR OFFICE, EMPLOYEES WORK IN A CONTAINED AREA, PROTECTED BY WALLS, FENCING AND IN MANY CASES SECURITY GUARDS OR SYSTEMS.

HOWEVER, WHEN WE CONSIDER THE SOCIAL SITUATION IN WHICH RAILWAYS OPERATE, WE SEE MILLIONS OF PASSENGERS AT STATIONS AND WE SEE THE GENERAL PUBLIC BY THE SIDE OF RAILWAY LINES, IN FACT MANY PEOPLE COME ON TO OUR PROPERTY LEGITIMATELY, AT CROSSINGS OR TO GAIN ACCESS. THE TASK OF ISOLATING OUR PEOPLE FROM THE GENERAL PUBLIC IS IMPOSSIBLE, AND THIS MAKES US VULNERABLE.

MY THIRD REASON IS SOCIETY ITSELF. WE HAVE SEEN A SUBSTANTIAL GROWTH IN CRIMINAL ACTIVITY, FOR RAILWAYS THAT OFTEN MANIFESTS IN THE FORM OF VANDALISM, OF TRACK AND TRAINS, OR HOOLIGANS THREATENING OUR STAFF AND PASSENGERS.

IN ADDITION, AND POTENTIALLY, THE BIGGEST THREAT, COMES FROM TERRORISM. IT IS NO LONGER CONTAINED TO THE COUNTRIES, THAT HAVE MANY YEARS OF EXPERIENCE IN DEALING WITH THE THREAT, WE ARE NOW WITNESSING TERRORISM IN AMERICA AND FRANCE, IN FACT, IT IS A GLOBAL CONCERN.

LADIES AND GENTLEMEN HOPEFULLY, YOU ACCEPT MY CONCERNS AND AGREE THAT THERE ARE MANY FACTORS WHICH CAN CAUSE CONSIDERABLE PERSONAL STRESS UPON OUR STAFF. STRESS THAT AFFECTS THEIR QUALITY OF LIFE AND ULTIMATELY, MANIFESTS AS A CONSIDERABLE COST BURDEN UPON OUR BUSINESS.

I BELIEVE WE NEED TO RECOGNISE THE CAUSES AND EFFECTS OF STRESS, AND TAKE POSITIVE ACTION, IF WE ARE TO MEET OUR "DUTY OF CARE" AND DISCHARGE OUR "MANAGEMENT RESPONSIBILITY".

WHAT, THEREFORE, IS STRESS? MY DICTIONARY DEFINES STRESS AS MENTAL, EMOTIONAL OR PHYSICAL STRAIN OR TENSION. IT CAN BE DEEP ROOTED AND THE SYMPTOMS, VERY OFTEN ARE NOT VISIBLE. IT IS FOR THIS REASON THAT A DIFFERENT APPROACH IS REQUIRED.

WITH ALL OTHER MATTERS RELATING TO SAFETY, WE AS AN INDUSTRY, TRY TO IDENTIFY, ELIMINATE OR MANAGE THE CAUSES OF THE RISK. BUT WITH STRESS, AND BECAUSE SO MANY OF THE CAUSES MAY BE OUTSIDE OUR CONTROL, WE HAVE TENDED TO LOOK AT MANAGING ONLY THE EFFECTS. THIS SITUATION IS CHANGING AS I WILL EXPLAIN LATER.

STRESS IS ALL AROUND US AND EFFECTS EVERYONE IN DIFFERENT WAYS. IT IS IN THE HOME, WHEN WE ARE OUT AND ABOUT, IN THE WORKPLACE AND, AS A RESULT, IT HAS BECOME AN ACCEPTED SITUATION THAT LIFE IS BAD, BUT THAT PEOPLE CAN COPE. I HAVE TO ADMIT, THIS PRESENTATION IS STRESSFUL FOR ME, BUT I AM EXPECTED TO COPE. INDEED, IF I DID NOT, THEN I MIGHT BE REGARDED AS INADEQUATE, OR POSSIBLY, NOT UP TO THE JOB.

WHY SHOULD IT BE SEEN AS STRONG TO BE ABLE TO COPE WITH A MEDICAL CONDITION BUT SEEN AS WEAK TO HAVE TO SEEK HELP. AT ONE TIME - DURING THE FIRST WORLD WAR - SHELL SHOCK WAS NOT ACCEPTED AS A MEDICAL CONDITION - SOME SOLDIERS WHO WERE SUFFERING FROM THIS WERE SHOT EITHER FOR DESERTION OR FOR COWARDICE. TIMES HAVE CHANGED AND IN RECENT WARS, PEOPLE SUFFERING ARE INVALIDED OUT OF THE COMBAT ZONE. HAD THEY BEEN ALLOWED TO REMAIN THEY WOULD HAVE BEEN A DANGER TO THEMSELVES AND TO THEIR COLLEAGUES. SHOULD THE SAME PRINCIPLES APPLY WITHIN RAILWAYS, SHOULD THOSE SUFFERING STRESS BE TEMPORARILY REMOVED FOR THEIR OWN AND OTHERS SAFETY.

THE RELATIONSHIP BETWEEN STRESS AND PERFORMANCE IS WELL UNDERSTOOD. PERFORMANCE DIMINISHES AS ATTENTION AND CONCENTRATION LEVELS FALL, AND I SUGGEST, THAT STRESS IN ONE FORM OR ANOTHER IS ONE OF THE HIGHEST CAUSAL FACTORS BEHIND ABSENTEEISM AS IT SAPS THE INDIVIDUALS SELF-CONFIDENCE, MORALE AND ABILITY AND WILLINGNESS TO DO THE JOB PROPERLY OR AT ALL. THIS MAKES STRESS A SAFETY RISK FACTOR.

A 1988 BRITISH GOVERNMENT REPORT ON MENTAL HEALTH AT WORK ESTIMATED THAT UP TO 40% OF ABSENTEEISM AT WORK THROUGH ILLNESS COULD BE ATTRIBUTED TO MENTAL OR EMOTIONAL PROBLEMS. IN MONEY TERMS, THIS EQUATES TODAY TO ABOUT £8 BILLION IN LOST HOURS TO INDUSTRY AND £26 BILLION IF ACCIDENTS AND SUB-STANDARD WORK ARE ADDED.

WE KNOW THAT MANY DAYS ARE LOST THROUGH ABSENTEEISM BECAUSE OF THE PSYCHOLOGICAL IMPACT OF SOME INCIDENTS ON STAFF. THERE ARE OTHER, CONCEALED, COSTS TO THE ORGANISATION OF NOT TAKING ADEQUATE CARE OF PEOPLE WHO HAVE BEEN AFFECTED. PEOPLE WHO ARE UPSET; WHO ARE PERFORMING BELOW PAR; PEOPLE WHO ARE LESS SAFETY-CONSCIOUS BECAUSE THEIR MINDS ARE PREOCCUPIED WITH WHAT HAS JUST HAPPENED TO THEM, ARE NOT THE MOST EFFECTIVE WORKERS. THERE IS ALSO THE LOSS FROM EARLY RETIREMENT DUE TO ILL HEALTH. EMPLOYEES WHO ARE DISTRESSED CANNOT GIVE THE LEVEL OF SERVICE REQUIRED FOR COMPANIES STRIVING TO PROVIDE A QUALITY SERVICE.

IF PEOPLE ARE THE RAILWAY'S MOST IMPORTANT INVESTMENT AND RESOURCE. IT MAKES GOOD BUSINESS SENSE TO TAKE EVERY STEP TO SAFEGUARD THEIR PSYCHOLOGICAL WELL-BEING.

OUR OCCUPATIONAL HEALTH DEPARTMENT TELL ME THAT STRESS ARISES IN THREE BROAD WAYS: INSTANT, INCREMENTAL AND POST-TRAUMATIC.
IF SOMEONE IS REALLY UNFORTUNATE, THEY CAN SUFFER FROM ALL THREE.

EXAMPLES OF INSTANT STRESS FOR OUR STAFF WOULD BE AN UNPROVOKED PHYSICAL ATTACK ON THE INDIVIDUAL BY A MEMBER OF THE PUBLIC, UNFORTUNATELY THE NUMBER OF ASSAULTS UPON RETAIL OR PLATFORM STAFF IS GROWING AT A CONCERNING RATE. NEARLY 20% OF LOST TIME ACCIDENTS ARE NOW ASSAULT RELATED. ANOTHER EXAMPLE OF INSTANT STRESS COULD BE WITNESSING THE SUDDEN DEATH OF SOMEONE, THROUGH BEING ELECTROCUTED OR BEING HIT BY A TRAIN.

TRAIN DRIVERS ARE THE ONE GROUP OF STAFF WHO WOULD SEEM TO RUN THE GREATEST RISK OF EXPERIENCING INSTANT STRESS. A TRAIN DRIVER CAN EXPERIENCE THE EXTREME TRAUMATIC STRESS OF SOMEONE COMMITTING SUICIDE UNDER HIS TRAIN. DRIVERS ALSO HAVE TO COPE WITH NEAR MISSES CAUSED BY PUBLIC TRESPASS AND WITH ROAD VEHICLES MOVING ACROSS LEVEL CROSSINGS BECAUSE THE CAR OR LORRY DRIVER CHOOSES NOT TO OBEY THE TRAFFIC LIGHTS OR RULES FOR CROSSING. THERE IS ALSO THE POTENTIALLY TERRIFYING EXPERIENCE OF HAVING A GREEN RAILWAY SIGNAL SUDDENLY REVERT TO DANGER IN FRONT OF THE TRAIN WHICH MAY BE TRAVELLING AT HIGH SPEED (UP TO 125 MPH) - THE DRIVER HAS NO WAY OF KNOWING WHETHER IT IS MERELY A MALFUNCTION OR WHETHER SOME UNSEEN OBSTRUCTION IS AHEAD - HE JUST HAS TO HOPE THE TRAIN STOPS BEFORE IT HITS SOMETHING.

WE REGULARLY HAVE SITUATIONS WHERE DRIVERS WHO HAVE SUFFERED INSTANT STRESS HAVE TO BE RELIEVED FROM DRIVING THEIR TRAIN BECAUSE THEY ARE THINKING ENTIRELY ABOUT THE INCIDENT AND IF THEY CONTINUED TO DRIVE, THEY WOULD NOT BE CONCENTRATING ON THE JOB AND WOULD BE A SAFETY RISK.

INCREMENTAL STRESS ARISES FROM A BUILD UP OF DIFFERENT PRESSURES. SOME MAY BE DOMESTIC PRESSURES AT HOME - ILLNESS IN THE FAMILY, BREAK DOWN OF RELATIONSHIPS CAUSING A DIFFICULT HOME LIFE. FINANCIAL PROBLEMS ARE A COMMON SOURCE OF WORRY AND STRESS.

WITHIN THE WORKPLACE, SOURCES OF INCREMENTAL STRESS COULD BE DISENCHANTMENT THROUGH UNKNOWN OR CHANGING GOALS. THE UK RAILWAY INDUSTRY HAS RECENTLY GONE THROUGH TREMENDOUS CHANGES IN THE PREPARATION FOR PRIVATISATION. AS OUR CHAIRMAN JOHN WELSBY SAYS IN HIS INTRODUCTION TO OUR LATEST ANNUAL REPORT "EVERY RAILWAY MAN AND WOMAN HAS BEEN EFFECTED, AND MANY STAFF AND MANAGERS HAVE FACED VERY CONSIDERABLE STRESSES AND STRAINS IN PREPARING THE RAILWAYS' OPERATIONS - AND THE MANY SUPPORTING SERVICES - FOR PRIVATISATION, WHILE ALSO WORKING EXTREMELY HARD TO PROVIDE CONTINUING SERVICES FOR THEIR CUSTOMERS. IT IS TO THE IMMENSE CREDIT OF SO MANY RAILWAY PEOPLE THAT, FOR EXAMPLE, SERVICE QUALITY HAS BEEN SUSTAINED WHILST COPING WITH THESE MAJOR ADDITIONAL WORKLOADS".

ARISING FROM THIS DISENCHANTMENT, BOREDOM CAN DEVELOP, PARTICULARLY WHERE PEOPLE DO NOT HAVE ENOUGH TO DO. ALTERNATIVELY, WHERE WE HAVE INTRODUCED SINGLE MANNING OF TRAINS, PARTICULARLY WITH HEAVY FREIGHT TRAINS, THERE ARE OCCASIONS WHERE DRIVERS MAY HAVE TO SIT ALONE IN THEIR LOCOMOTIVE IN SOME REMOTE PART OF THE COUNTRY WAITING FOR A TRAIN PATH. THIS CAN BE A VERY DULL AND UNREWARDING EXPERIENCE AND COULD LEAD TO A LACK OF VIGILANCE WHEN THE TRAIN GETS UNDER WAY AGAIN. THESE STRESSES WILL, OVER TIME, BUILD UP AND CAN DEVELOP INTO A SAFETY RISK SUCH AS A SIGNAL BEING PASSED AT DANGER.

THE TOTAL NUMBER OF SIGNALS PASSED AT DANGER ON THE UK RAILWAY NETWORK OVER THE PAST SIX YEARS HAS REMAINED FAIRLY CONSTANT AT AROUND THE 880 MARK ANNUALLY, BUT THE SAFETY RISK FROM A TRAIN PASSING A DANGER SIGNAL COULD, OF COURSE, BE HIGH. CONSEQUENTLY, WE CATEGORISE SIGNALS PASSED AT DANGER INTO THOSE WHICH ARE SERIOUS, I.E. THOSE WHICH CAUSE DAMAGE OR INJURY. SERIOUS SIGNALS PASSED AT DANGER HAVE DURING THE SAME PERIOD DECLINED FROM 22% TO 11% OF THE TOTAL AND THE MAJORITY OF SERIOUS ONES INVOLVE ONLY DAMAGE SUCH AS POINTS BEING RUN THROUGH AND DO NOT INVOLVE THE POSSIBILITY OF CONFLICTING TRAIN MOVEMENTS WHICH COULD LEAD TO A COLLISION. NEVERTHELESS, IT IS THE POTENTIAL FOR CATASTROPHE THAT CONCERNS US, AND WHETHER THERE IS A LINK BETWEEN SIGNALS PASSED AT DANGER AND INATTENTION THROUGH STRESS. WE ARE PAYING A GREAT DEAL OF ATTENTION TO CAUSAL FACTORS.

FATIGUE NOT ONLY ARISES FROM STRESS BUT, EQUALLY, CAUSES IT. THE RAILWAY INDUSTRY IS ONE OF THOSE ROUND-THE-CLOCK BUSINESSES WHERE HUMAN FATIGUE SIGNIFICANTLY IMPACTS ONTO PRODUCTIVITY, QUALITY, SAFETY, LABOUR RELATIONS AND THE BUSINESS BOTTOM LINE. RAILWAY OPERATION INVOLVES CONSIDERABLE NUMBERS OF STAFF IN SHIFT WORK BUT HUMANS WERE NOT DESIGNED FOR SUSTAINED VIGILANCE AT NIGHT. WHETHER WE ARE AWAKE OR ASLEEP, BODY FUNCTIONS CONTINUE TO FOLLOW THEIR CIRCADIAN RHYTHMS AND ROUND-THE-CLOCK WORKERS FREQUENTLY NOD-OFF ESPECIALLY IN THE EARLY MORNING HOURS. IF, OVER A PERIOD OF TIME, A PERSON HAS DISRUPTED SLEEP LEADING TO REDUCED SLEEP, TOGETHER WITH OTHER FACTORS CREATED BY SHIFT WORK SUCH AS IRREGULAR MEAL TIMES (WHICH THEMSELVES CAN EFFECT DIET) STRESS LEVELS BUILD AND ALERTNESS DETERIORATES.

HARASSMENT IN ITS VARIOUS FORMS OF PREJUDICE, SEXUAL DISCRIMINATION, BULLYING, INTIMIDATION AND VICTIMISATION ALL CONTRIBUTE TO STRESS BUILD UP.

THE RAILWAY INDUSTRY HAS A DRINK AND DRUGS POLICY WHERE STAFF ARE NOT PERMITTED TO REPORT FOR DUTY UNDER THEIR INFLUENCE OR PARTAKE DURING THE COURSE OF DUTY. MANY PEOPLE ENJOY A DRINK BUT FOR OUR STAFF, PARTICULARLY DRIVERS, THERE IS THE WORRY THAT IF THEY GO FOR A SOCIAL EVENING WITH FRIENDS TO RELAX, THEY HAVE TO WATCH THEIR CONSUMPTION VERY CLOSELY BECAUSE IF THEY ARE OVER THE LIMIT AND SOMETHING HAPPENS, THEY COULD BE SACKED, POSSIBLY EVEN IMPRISONED EVEN THOUGH THEY MAY NOT HAVE BEEN AT FAULT. I AM NOT SAYING THAT IT IS WRONG TO HAVE A TOUGH DRINK AND DRUGS POLICY, BUT IT IS A SOURCE OF STRESS TO SOME OF OUR PEOPLE.

POST-TRAUMATIC STRESS, AS ITS TITLE SUGGESTS, ARISES AS A RESULT OF EXPERIENCING INCIDENTS. A TRAIN DRIVER WHO HAS RUN SOMEONE DOWN OR BEEN INVOLVED IN AN INCIDENT OF SOME KIND MAY DEVELOP STRESS FROM THE MEMORY OF THE INCIDENT. THIS CAN ARISE FROM NERVES OR TRAUMA. POLICE OFFICERS OR RAILWAY STAFF CALLED TO THE SITE OF AN ACCIDENT TO DEAL WITH THE AFTERMATH MAY KNOW FULL WELL WHAT THEY MAY SEE OR EXPERIENCE AND CAN DEAL WITH IT AT THE TIME, BUT MAY WELL EXPERIENCE TRAUMA AND STRESS AFTERWARDS.

STAFF WHO ARE WITNESSES TO, OR SURVIVORS FROM, AN INCIDENT ALSO SUFFER FROM STRESS AND TRAUMA AND NEED TO BE COUNSELLED.

DURING THE FIVE YEARS 1989 TO 1993, THERE WERE 1351 PEOPLE KILLED ON RAILWAY PROPERTY. THIS WAS NOT THE RESULT OF SOME MASSIVE BREAKDOWN IN SAFETY PROCEDURES FOR THESE PEOPLE WERE NOT KILLED IN TRAIN CRASHES BUT WERE TRESPASSERS, SUICIDES, OTHER MEMBERS OF THE PUBLIC OR STAFF ON THE TRACK HIT BY MOVING TRAINS. THIS POTENTIALLY MEANS THAT 1351 DRIVERS SUFFERED INSTANT STRESS - PROBABLY FOLLOWED BY POST TRAUMATIC STRESS. 1351 POLICE OFFICERS AND OR OTHER STAFF WHO HAD TO PICK UP THE HUMAN REMAINS SUFFERED INCREMENTAL AND POST TRAUMATIC STRESS. SO TOO DID 1351 TRAIN MAINTENANCE STAFF WHO HAD TO CLEAN THE TRAIN AFTERWARDS - A TOTAL OF 4053 MEMBERS OF STAFF. WHAT IS EVEN MORE WORRYING IS THE FACT THAT WE HAVE AROUND 13,000 TRAIN DRIVERS IN TOTAL AND STATISTICS SHOW THAT THE RATE OF SUICIDE AND TRESPASSER DEATH, BY FAR THE HIGHEST INDIVIDUAL SOURCE, REMAINS ROUGHLY CONSTANT. THEREFORE, THE LIKELIHOOD OF A TRAIN DRIVER EXPERIENCING AT LEAST ONE DEATH UNDER HIS TRAIN IS HIGH AND, UNFORTUNATELY, I KNOW OF INSTANCES WHERE DRIVERS HAVE HAD THREE SUICIDES AND HAVE GIVEN UP DRIVING AS A RESULT.

WHAT SORT OF EFFECT DOES STRESS HAVE ON PEOPLE AND HOW MIGHT THEY BEHAVE AS A RESULT?

THE GREATEST SAFETY RISK FOR THE INDUSTRY MUST BE THAT A KEY FRONT LINE EMPLOYEE SUCH AS A TRAIN DRIVER, OR IN THE CASE OF RAILTRACK, A SIGNALMAN, WILL NOT BE CONCENTRATING ON WHAT HE OR SHE IS DOING. WITH ALL THE PROTECTION AND PROCEDURAL ARRANGEMENTS THAT HAVE BEEN DEVELOPED OVER THE YEARS FOLLOWING VARIOUS RAILWAY ACCIDENTS, IT IS NOW VERY DIFFICULT FOR A SIGNALMAN TO DO SOMETHING THAT COULD RESULT IN DISASTER.
NOT SO WITH TRAIN DRIVERS WHO, FOR GOOD REASON, HAVE THE ABILITY TO CANCEL AND OVERRIDE PROTECTION AND WARNING SYSTEMS. A DRIVER COULD BECOME DISORIENTATED AND BRAKE TOO LATE FOR A SPEED RESTRICTION OR A STATION STOP. TAKING THIS A STAGE FURTHER, BY CANCELLING VARIOUS ON-TRAIN SAFETY DEVICES ASSOCIATED WITH THE SIGNALLING SYSTEM WITHOUT CONSCIOUSLY REGISTERING WHAT HE IS DOING, THE DRIVER COULD ALLOW HIS TRAIN TO PASS A SIGNAL AT DANGER. THE SEVERE CONSEQUENCES OF THIS CAN EASILY BE IMAGINED. WE AS MANAGERS HAVE TO RECOGNISE THE POSSIBLY SEVERE CONSEQUENCES OF THESE ACTIONS.

OTHER DIRECT EFFECTS FROM STRESS ARE THAT STAFF FEEL THEY CANNOT COPE WITH THEIR JOBS. THEIR SELF-CONFIDENCE AND SELF-ESTEEM GOES AND IT IS THE EASY OPTION FOR THE EMPLOYEE TO TAKE THE DAY OFF' - IN A WORD ABSENTEEISM. THERE ARE, HOWEVER, PERFECTLY LEGITIMATE CASES OF DEPRESSION WHICH CAUSE STAFF TO GO SICK AND WE HAVE HAD CASES WHERE PEOPLE HAVE BEEN OFF WORK FOR MANY MONTHS OR HAVE HAD TO LEAVE THE INDUSTRY ON HEALTH GROUNDS.

WE KNOW THAT LONG TERM STRESS CAN CREATE ILL HEALTH AND, IN EXTREME CASES, STRESS COULD EVEN LEAD TO SOMEONE TAKING THEIR OWN LIFE.

WHEN I FIRST JOINED THE RAILWAY 25 YEARS AGO, STRESS WAS NOT A RECOGNISED CONDITION. TODAY WITH LESS PEOPLE DOING MORE OF THE WORK, PRESSURE AND ITS ASSOCIATED STRESS LEVELS ARE CLEARLY RECOGNISED AND UNDERSTOOD. THE INDUSTRY NOW TAKES STRESS VERY SERIOUSLY INDEED. WE HAVE TO BECAUSE IT IS THE LAW. UNDER THE HEALTH AND SAFETY AT WORK ACT (1974) EMPLOYERS HAVE A 'DUTY OF CARE' FOR THE HEALTH AND SAFETY OF THEIR EMPLOYEES AND UNDER THE MANAGEMENT OF HEALTH AND SAFETY REGULATIONS (1992), MANAGERS ARE REQUIRED TO MAKE AN ASSESSMENT OF RISK, INCLUDING THAT TO MENTAL HEALTH. RECENT CASES IN THE HIGH COURTS EMPHASISE THE "DUTY OF CARE". COMPENSATION PAYMENTS NOW REGULARLY BEING AWARDED AGAINST EMPLOYERS WHO HAVE, IN THE JUDGE'S VIEW, NOT MET THEIR DUTY.

SO, WHAT DO WE DO TO DEAL WITH THE PROBLEM?

WITHIN BRITISH RAIL, WE HAVE ALWAYS HAD A GOOD TECHNICAL AND SAFETY RECORD BUT, TRADITIONALLY, WE CAN BE LESS EFFECTIVE ON ISSUES WHICH AFFECT PEOPLE. THERE WAS AN URGENT NEED FOR THE IMPLEMENTATION OF A MANDATORY SYSTEM WHICH ENSURED EVERYONE WHO HAD BEEN INVOLVED IN ANY SORT OF INCIDENT COULD RETURN TO WORK HEALTHY IN MIND AND BODY.

THE INDUSTRY INTRODUCED A PROGRAMME CALLED "CHAIN OF CARE AND SUPPORT" WHICH TRIES TO EASE THE EFFECTS OF STRESSFUL OR TRAUMATIC INCIDENTS BY COUNSELLING.

THE PURPOSE OF THE PROGRAMME IS NOT TO LAY YET ANOTHER BURDEN ON LINE MANAGERS, BUT TO PROVIDE A USEFUL RESOURCE FOR SUPPORTING STAFF. IN THE CLIMATE OF STRUCTURAL CHANGE, WE HAVE TO RECOGNISE THE IMPORTANCE OF MAXIMISING THE EFFECTIVENESS OF THOSE WHO WORK FOR US. RESPONDING QUICKLY TO THE NEEDS OF A MEMBER OF STAFF WHO HAS BEEN THROUGH A DISTRESSING EXPERIENCE IS AN IMPORTANT PART OF THIS. AS MANAGERS, WE MUST ACCEPT FIRST LINE RESPONSIBILITY FOR THE WELL-BEING OF OUR STAFF, AND USE ALL THE RESOURCES AT OUR DISPOSAL.

RESEARCH SHOWS THAT THE RISK OF SOMEONE SUFFERING LONG-TERM EFFECTS FROM A DISTRESSING INCIDENT MAY BE REDUCED IF THEY ARE AWARE OF THE TYPES OF SITUATION WHICH COULD OCCUR AND UNDERSTAND THAT A SUPPORT SERVICE IS AVAILABLE. SICKNESS ABSENCE ALONE MAY BE REDUCED BY UP TO 60% IF COUNSELLING SERVICES ARE AVAILABLE BOTH BEFORE AND AFTER INCIDENTS.

NONE OF US LIKES TO THINK ABOUT THE POSSIBILITY OF BEING INVOLVED IN AN INCIDENT INVOLVING A FATALITY - OR IN DISTRESSING OCCURRENCES SUCH AS VIOLENT ASSAULT OR SERIOUS ACCIDENTS. BUT A MANAGER MUST BE PREPARED TO DEAL QUICKLY AND UNDERSTANDINGLY WITH STAFF WHO HAVE.

THE PROCESS OFFERS EVERY MEMBER OF STAFF INVOLVED IN A DISTRESSING INCIDENT OR ACCIDENT THE RIGHT TO TALK TO A TRAINED COUNSELLOR.

THERE ARE TWO ELEMENTS TO OUR POLICY - PREVENTION AND CARE.

PREVENTION MEANS ADVISING PEOPLE IN ADVANCE ABOUT DISTRESSING INCIDENTS THAT THEY MIGHT ENCOUNTER IN THE COURSE OF THEIR WORK AND REASSURING THEM THAT IT IS NORMAL TO BE DISTRESSED BY SUCH INCIDENTS.

CARE MEANS BEING SENSITIVE TO THE POSSIBLE EFFECTS OF SUCH INCIDENTS ON THE STAFF INVOLVED AND OF BEING READY TO MEET THEIR NEEDS.

RESPONSIBILITY FOR THE CARE OF STAFF WHO ARE DISTRESSED, RESTS WITH THE MANAGER OR SUPERVISOR. THIS MEANS TAKING CARE OF PRACTICAL DETAILS SUCH AS GIVING A PERSON A QUIET PLACE TO SIT AND TAKE STOCK OF WHAT HAS HAPPENED AND ASSESSING THEIR FITNESS TO CONTINUE DUTY OR ARRANGING TRANSPORT HOME IF THEY ARE NOT. IT ALSO INCLUDES LISTENING TO THE EMPLOYEES' ACCOUNT OF EVENTS, REASSURING THEM THAT IT IS QUITE NATURAL TO BE DISTRESSED BY WHAT HAS HAPPENED AND OFFER THE SERVICES OF A TRAINED COUNSELLOR. ALL THIS EFFORT IS DESIGNED TO REDUCE THE STRESS PLACED UPON THE EMPLOYEE.

COUNSELLORS ARE CAREFULLY SELECTED AND TRAINED INDIVIDUALS WHOSE ROLE IS TO BE AN EMPATHETIC LISTENER WHO GUARANTEES CONFIDENTIALITY. HE OR SHE WILL PROVIDE ON-GOING SUPPORT AS REQUIRED BY THE EMPLOYEE, PARTICULARLY AT KEY TIMES SUCH AS THE ANNIVERSARY OF THE INCIDENT. COUNSELLORS ASSESS THE REACTIONS OF EMPLOYEES AND LEARN TO RECOGNISE ANY ABNORMAL RESPONSES AND THOSE WHO MAY BE EXPERIENCING ONGOING EMOTIONAL PROBLEMS WILL BE REFERRED TO THE OCCUPATIONAL HEALTH SERVICE FOR ASSESSMENT. IF STAFF REQUIRE PROFESSIONAL HELP, ARRANGEMENTS WILL BE MADE FOR THEM. THE ROLE OF THE COUNSELLOR IS NOT TO MAKE THE STAFF FEEL THEY ARE BEING `WATCHED' OR THAT ADDITIONAL TREATMENT IS DESIGNED TO FORCE THEM OUT OF THE INDUSTRY. ALL THE EFFORT IS AIMED AT REDUCING THE STRESS AND ENSURING STAFF FULLY RECOVER FROM THEIR EXPERIENCE.

LADIES AND GENTLEMEN, IN CONCLUSION, I WOULD SUGGEST TO YOU THAT PERSONAL STRESS HAS A SIGNIFICANT IMPACT UPON RAILWAY OPERATIONS. IT SERIOUSLY AFFECTS THE QUALITY OF LIFE OF OUR STAFF AND HAS A MAJOR IMPACT UPON BUSINESS RESULTS. I BELIEVE ACTION IS REQUIRED IF OUR MANAGERS ARE TO DISCHARGE THEIR MORAL AND LEGAL OBLIGATIONS. I SUSPECT THAT NOW EMPLOYEES ARE WINNING THEIR CASE IN COURTS OF LAW THAT THERE WILL BE A SIGNIFICANT INCREASE IN THE NUMBER AND SIZE OF CLAIMS, AND THAT WITHOUT POLICIES IN PLACE, EMPLOYERS WILL HAVE NO DEFENCE. I BELIEVE THAT OUR ABILITY TO REDUCE OUR EXPOSURE TO SUICIDE AND TRESPASS RELATED DEATHS IS LIMITED BECAUSE OF THE NATURE OF OUR OPERATION. THEREFORE, THE BEST WE CAN DO IS TO PREVENT STRESS THROUGH TRAINING OUR PEOPLE TO PREPARE THEM FOR EVENTS AND TO CARE FOR THEM AFTERWARDS. LADIES AND GENTLEMEN THANK YOU FOR YOUR TIME AND ATTENTION, I WOULD BE HAPPY TO HEAR YOUR VIEWS.

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Auditing Safety Culture

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Auditing Safety Culture

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"AUDITING SAFETY CULTURE"

By David Maidment
Controller, Safety Policy
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1. BACKGROUND

The changes within the UK railways from a unitary organisation to a multi company environment in the space of a year has led, or will lead, to fundamental changes in values and policies of management teams. Survival, competitiveness, financing and structural change will be foremost in the minds of the top management teams of each embryonic company. At workforce level, though their daily tasks are likely to have little variation, the personnel are affected by future uncertainty, be this job security or who their future 'bosses' will be. The relatively stable environment is vanishing and staff, supervisors, lower grade management will be attempting to create a 'new' stability by interpreting the key values of their superiors.

For instance, a management team continually complaining about the perceived "iniquitous actions and policies of Railtrack" are going to give strong 'signals' to their work force on the way it should be behaving and acting at the organisational interface with Railtrack; be it driver to signaller or Infrastructure Maintenance Unit manager to Railtrack Zonal Infrastructure Manager.

In other words a culture or sub-culture will quickly develop within the 'vacuum' caused by the structural changes within the industry.

Such interfaces between organisations have a safety significance, ie the organisational interfaces are the horizontal culture and the beliefs and values within the organisation, show the vertical culture. The tools discussed in this paper focus on the vertical culture within any organisation. They measure the beliefs held by, and the interaction between, people.

2. CURRENT POSITION

One of the key means of assessing that the proper safety processes are in place is by auditing. Though the International Safety Rating System (ISRS) has been developed as an auditing technique to provide a score on the quality of safety management, and though the safety case follow-up audits will check that all principles, processes and structures of a company Railway Safety Case are in place, neither adequately tests for any gap between the intended outcome of the safety management system and the group behaviour which constitutes the reality of 'culture' of the company.

British Rail and, subsequently, Railtrack has developed, in conjunction with Professor James Reason of Manchester University, a diagnostic tool for testing the 'safety health' of an organisation as perceived at the workface. The technique developed - now called TARGET - has been described in concept at previous seminars. Its value has now been well accepted following widescale prototyping, and a complete software and training package is currently being offered to railway managers. (A description of the tool for potential users is attached as Appendix A). It is intended that this auditing technique of the management systems 'precursors' to accidents is complementary to use of the ISRS system.

3. THE SEARCH FOR A NEW TECHNIQUE

The successes of 'TARGET' indicated to us that it may be possible to build on that methodology to look at safety culture throughout an organisation, and test its documented commitments against less tangible criteria - a search to evaluate compliance with the 'spirit' rather than the 'letter' of the law.

Railtrack's Safety Policy Unit has developed a remit, carried out by its Human Factors Analyst, to:

- Measure and improve safety culture within the Railway Group
- Evaluate systems/tools and techniques which give a measure of safety culture including:
    - ♦ the aspects of safety culture which the techniques address
    - ♦ the use of the technique in the work place
    - ♦ the ease or complexity of application in the work place
    - ♦ comparison of the techniques
- Recommend a way forward appropriate for the UK railway industry.

The first phase of the study has been to identify techniques claimed by Consultants or Academics to address safety culture, observe where it has been introduced, and assess the benefits claimed with managers of the industries where such techniques have been introduced.

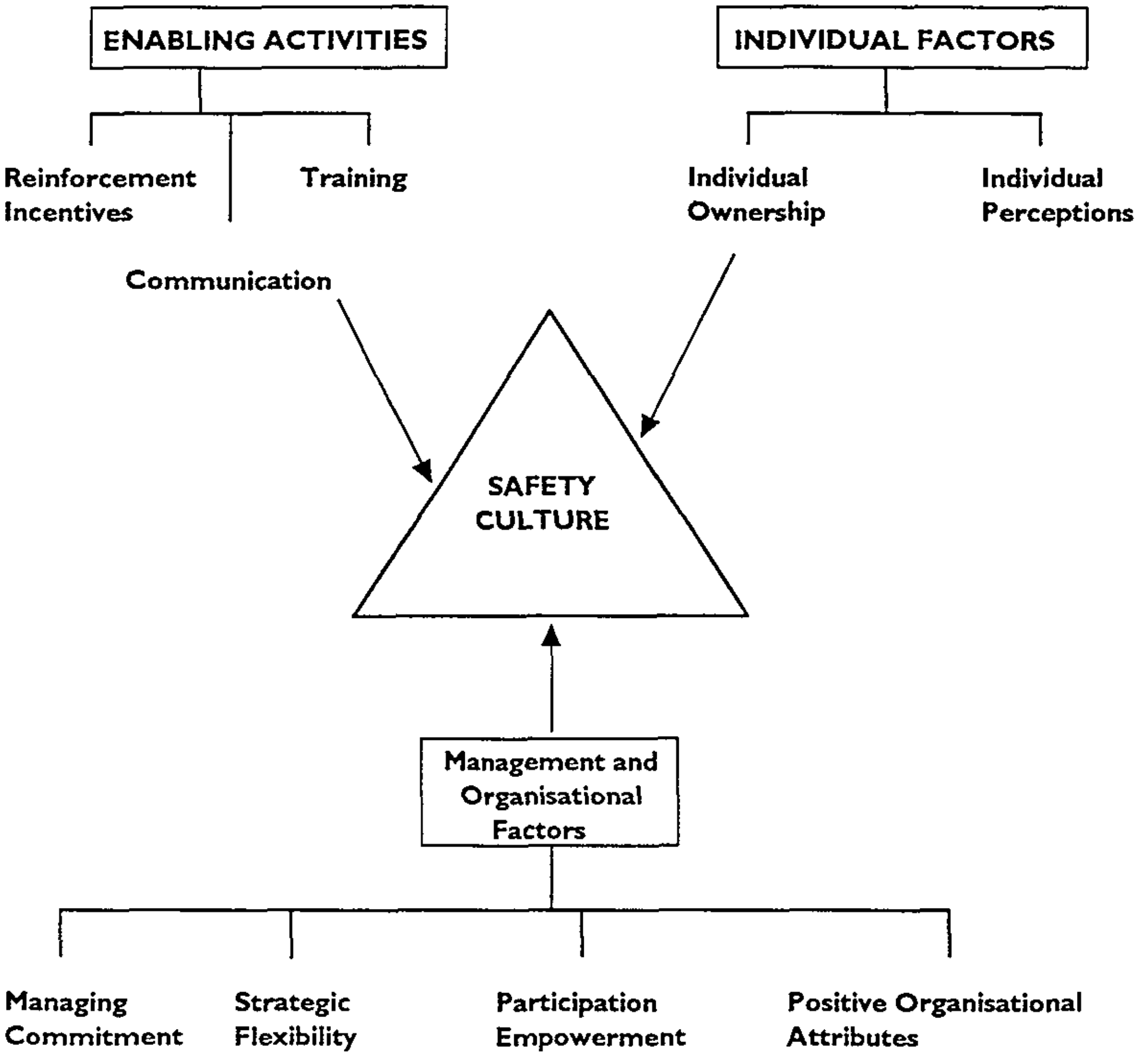
Seven different systems were investigated. The philosophy behind them is now described - which gives implicit or explicit definition of what is understood by safety culture. Where UK experience of the system in operation was observed, this is also described. In some cases, the system described is only a proposal: in others, no UK implementation could be identified for validation.

4. SAFETY CULTURE ASSESSMENT TOOLS INVESTIGATED

4.1 System 1

The first technique studied was based on the diagrammatic definition of safety culture shown below. The creators of the technique undertook a comprehensive literature search and concluded that there were 129 parameters of safety culture.

These parameters were organised into key groups (ie the lowest elements on the following diagram).



When using the technique/tool, each of the 3 key groups are assessed via a different method.

- Management and organisation via management interviews. These allow managers to explain systems, procedures and values with prompts from the interviewer when necessary. Management often choose to give examples to explain their answers which can be documented providing evidence of beliefs/attitudes.

- Enabling activities via a checklist or structured interview. The structure of the checklist is based on management answers/comments in their interviews. This develops deeper questioning about systems/procedures, attitudes and values in place in the organisation.

- Individual factors are assessed via safety attitude questionnaire. The questionnaire takes 30 minutes to be completed. A copy is sent individually to every member of staff, (including those interviewed). An expected response rate is 50% and it is accepted that this will provide a representative sample for the organisation concerned.

Following the interviewing and questionnaire collection, analysis of results is currently performed by hand. This is a fairly lengthy process although it is suggested that this could be proceduralised and possibly developed as a computer system. The analysis allows very specific recommendations to be made.

Those involved in the process of interview found the open questions interesting, allowing freedom in answering. Many of those interviewed gave examples to explain answers as would occur in an audit interview; this was not a requirement but provided the interviewer with a backdrop upon which recommendations could be based.

The questionnaires were not perceived as complex. Those completing them found the explanations within the questionnaire useful. The questionnaires took staff between 20 and 30 minutes to complete depending on their direct involvement in safety issues.

A management team where this system had been implemented found that the recommendations were specific enough that direct action could be taken.

Overall, they accepted that the whole process had been useful, and would guide them to a number of improvements. They are satisfied that the time spent on the study would 'reap rewards' over the next year. An intention to assess the culture again in a year's time was expressed.

4.2 System 2

The approach involves both management and staff from day one. Management have to own/want the technique before the process can start. The consultants produce or develop a company specific list of critical behaviours that have resulted in accidents. This involves examining accident/near miss data with a steering committee of staff chosen according to their roles in the workplace. These people are able to add other critical behaviours based on their knowledge/experience of the work.

Once identified the behaviours are categorised using a pareto analysis. A data sheet can then be developed. This describes the critical elements and their related behaviours grouped into categories. These sheets are used by staff who observe other staff working. They score each behaviour on a suitable scale and and comments. To ensure consistency between observers a list of definitions is produced and owned by the staff involved. The definitions are not a re-write of any rules or regulations.

A large percentage of staff (over 50%) will observe at some time. Training is given in communication and feedback and this raises the awareness of the observer to concerns/anxieties the observed person may experience whilst being observed.

Following observation, data is analysed by a group of sharp end staff. They are able to focus on issues raised and develop an action plan. This will be owned by the staff as their comments/observations lead to its development.

The system's creators are an American Company, and whilst many examples are quoted of American companies demonstrating accident improvement rates as a result, no UK companies appear to have adopted it. The initial formulation of the critical behaviours linked with accident causation is very similar to the process developed with Professor Reason for TARGET.

4.3 System 3

The next technique considered is an evaluation program designed for self evaluation or auditing. The system is highly flexible. It can be used with a standard set of questions, or with a company's own specific question set. It can include questions with percentage or numerical answers, and word or phrase answers. It has sophisticated analysis ability which can be customised to meet each organisations' needs. There is the ability to track and manage recommendations/evaluations and audit diaries.

The audit system presents the questions in a user friendly manner, which enables easy input of answers, notes and recommendations. The questions identify areas of risk and evaluate how well the organisation is managing this risk. Results of a number of analyses can be compared and combined to produce summaries for different parts of an organisation.

The software will produce the data for reports automatically, will print out the reports in a variety of formats and will also present reported data graphically.

It is not currently a tool which looks at safety culture. It is a flexible system already able to carry various question sets, perform a number of analyses, and produce output in the form of reports. There is no reason why this software could be used as the platform for questions looking specifically at Safety Culture.

4.4 System 4

The next approach considered was an academic study focused on one 'hi-tech' plant site. The safety culture audit was centred round a 'safety survey'.

The survey aimed to:

- Analyse employee perceptions and attitudes, respect of hazards, risks and safety procedures.
- Develop improvement plans based on the survey's findings.
- Develop and improve the safety culture.

Focus groups identified aspects of work at the site which caused concern:

- Organisation and Relationships
- Personnel
- General Management
- Risk Management
- Emergency actions

Group discussions were used to compile and structure a questionnaire. This was tested and rewritten following comments/criticisms. The final questionnaire contained 172 'attitude statements' graded into a number of subject areas which allowed feelings and views to be expressed about:

- the individual's job
- the performance of health and safety departments, health physicists, safety officers and safety committees
- the role and quality of service provided by safety representatives
- the quality of 'lost time' accident reporting methods
- the nature and use of safety rules and safety instructions
- the need and use of the 'permit to work' system
- the way in which accidents and near miss reports are followed up
- site emergency systems

- design of plant, buildings and equipment
- selection and training of employees
- relationship with the safety regulator
- methods used to foster and develop trust, team work and commitment to safety.

The analysis was performed using a customised computer system. This system uses 'principle Components Analysis' to analyse the information. The 172 statements were grouped into 20 'underlying attitudes' which relate to 20 site related issues. The extent to which each 'attitude statement' contributes to an 'underlying attitude' was measured and weighted. This resulted in a set of dependable scores measuring each person's attitude towards the nine key safety issues.

The analysis was collated further to make comparisons between working groups. This allowed the opportunity for improvements to take place. The study was able to identify a set of attitudes for groups of staff who had a close involvement in an accident or near miss and those who had not. This allowed safety improvements to be based, for the first time, on firm objective observation and measurement. Employees who had not had an accident tended to have a higher degree of 'contentment with the job', than those who had experienced accidents. The discontentment was strongly correlated with:

- inability to influence plant design
- confidence in safety procedures
- personal understanding of safety rules.

These parameters are open to change and have a direct influence on the 'discontentment' attitude. Other relationships have also been highlighted.

They study also found a strong correlation between accident-free behaviour and an individual's perceived self-control over safety-related issues and activities. Improvement was expected through the participation of individuals and teams in ensuring that safety aspects are included at both the planning and review stages of all jobs.

4.5 System 5

The fifth system considered was in the form of a proposal to Railtrack, rather than an applied methodology.

The proposal would be to develop a framework of specific organisational characteristics which give rise to good safety performance. The framework would be used to develop and assess safety culture. The framework would be extended to form a practical tool to assist railway companies, develop good practices for improved safety and loss control performance, and the process of 'peer' review and emulation.

The framework would be developed with teams of employees including operational managers and first-line supervisors. A combination of a workshop environment and structured interviews is suggested as the most effective mechanism for building the framework. An outline framework is set out below.

Levels 3 and 4 focus principally on the features required for an effective safety culture. Levels 1 and 2 focus on the tangible evidence of the culture.

For example:

Level 4	Managers motivate staff and practice tangible recognition for particularly effective commitment to safety.
Level 3	Managers regularly review the performance of Staff with assessment of their attitude to safety.
Level 2	Are Staff qualified and do they have sufficient competence to handle any abnormal situation?
Level 1 i)	Awareness of the need for balance and experience in the team
ii)	Favourable comment by staff on manager's ability and willingness to acknowledge safe working.

The framework and its application would differ from and complement, and ISRS style of audit, by concentrating on discussion and evaluation of individual and collective attitudes and knowledge, rather than the technical contents and experience of procedures and systems.

To achieve this it would be necessary to create guide questions which are open and techniques which invite discussion and explanation.

The consultant proposes to establish safety culture assessments which focus on the jobs that people do and their understanding/support in the tasks they actually perform. The actual questions asked may need to be tailored to the job of the person being interviewed so that it can be related to that person's practical experience. In each case, notes would be provided to guide the assessor so that supplementary questions can be asked as appropriate. Key indicators to Safety Culture would be developed and listed so that responses could be judged as indicative of Safety Culture effectiveness.

The consultant recommends a 6 phase approach to tool development.

(i) Develop a framework based on experience with the Nuclear industry.

(ii) Establish a methodology for applying framework to assess safety culture.

(iii) Pilot safety culture assessment.

(iv) Recommend process for "roll-out".

(v) Train assessment team members in the techniques of Safety Culture Assessment.

(vi) Investigate the wider benefits of the methodology.

4.6 System 6

The next system considered was based on a study conducted by a University for one of the Network South East Railway's civil engineering maintenance divisions.

The core approach used to assess safety culture consisted of in-depth interviews together with the possibility of follow-up discussions on collection of incidental information gleaned by spending time in the working environment. The in-depth interviews, which lasted up to 2 hours, contained 3 main components:

i) The critical Incident Technique - This involved description of accidents or near misses and was intended to reveal how staff explained them in terms of attribution and prevention and to reveal perceptions of factors that contribute to a safe or unsafe working environment.

ii) General Questions - These were intended to gain an insight into how staff viewed safety at their place of work by obtaining perceptions of risk. Work hazards, levels of safety awareness and of safety performance, conditions under which staff are most likely to cut corners, levels of fatalism, changes affecting safety, the usefulness of rules, mechanisms for monitoring safety and safety systems in general.

iii) Repertory Grid - This was used to explore criteria used by Staff to explain contrasts in safety performance and to identify how staff construe good and poor safety performance and safety management within the company. An additional aim was to develop a measure based on the emerging dimensions with which to rate local safety culture and safety behaviour.

The interview data produced an array of results. These results gave differences between high and low accident sections/gangs. Specifically this related to the section leaders of safe sections. Their leadership style affects the extent to which staff feel valued, fairly treated and informed. The outcome of this is that staff feel a greater sense of loyalty to their section manager, and believe he is sincere in setting high safety standards.

The results, one above being only an example, were found to be constructive and useful by the departments involved.

The work was time consuming and required the use of "experts" to collate and interpret the results.

The technique would need formalising and producing in the form of a tool for ownership within an organisation.

4.7 System 7

Another University has developed a safety culture assessment tool for a number of industries. Each is specifically developed to the companies requirements and needs, yet can build on previous experiences in terms of development and implementation.

Their first tool was for a major UK nationalised industry who had found that they had reached a plateau of accident rates. They were interested in staff attitude to safety.

The technique developed involves interviews with management, supervisors and sharp end staff. Questionnaires are also distributed to all staff. The questionnaire is a standard format, and changes are made to terminology or work types mentioned depending on the industry involved. Any issue of particular interest to management can be added.

The University holds a database of 80 company's data; this can be used as a benchmark. The data generated is more detailed than just looking at the accident trend. It can therefore be of use in Risk Assessments.

The University is currently developing a computerised system for analysis and comparing of data.

5 SUMMARY

The report has outlined 7 tools all looking at Safety Culture or some part of it. Each tool uses a number of evaluation techniques, usually a combination of interviews and questionnaires. The length of interview or questionnaire varies. All currently use an expert to run interviews and collate/evaluate results of questionnaires.

For the companies using the techniques the time spent has been of value. Results and recommendations have been accepted and rolled forward in the form of action plans.

Each technique gains from staff ownership and hence involves staff from day one of assessment.

6. A WAY FORWARD FOR THE UK RAILWAY GROUP

None of the tools evaluated are suitable for direct implementation within the Railway. Each would need customising for application.

For a tool to be of great use, it would need to be used in-house, without the need for buying in an 'expert' each time an assessment is to take place. Hence, the tool should include a detailed analysis system (probably computer based). The 'question set' also should have flexibility to suit the differing operations of the separate companies.

We intend that work be put to tender to:

- customise a safety culture tool for railway application
- develop/customise an analysis/reporting computer system
- pilot the tool in one railway company.

D J Maidment
Railtrack Safety & Standards, September 1995

APPENDIX A

Target
zero accidents

What is "Target"?

Target, formerly called "Review", is a new, effective and flexible safety management tool. It has been created specifically for increasing safety within the railway. It focuses on identifying potential problems before an accident happens. *Target* does this by seeking input from those who are at the sharp end of safety critical operations – drivers, shunters, signalmen etc.

Emphasis has been placed in the past on the violation of rules and the human error factor in accidents. Improving safety has therefore been geared to trying to prevent a recurrence of a particular accident. This has usually been through engineered safety measures and amendments to the Rule Book.

But some major recent catastrophes have shown that staff at the sharp end are the victims of inbuilt failures in the organisation – there is "an accident waiting to happen". *Target* aims to open up an organisation to reveal these potential accidents before they happen. By identifying these potential problems it is possible to both eliminate failures at source and improve the safety culture ○

How *Target* improves safety – the theory

Target provides a mechanism for collecting the opinions, ideas and experiences of all staff involved in safety critical operations. It does this on a regular, formal basis but with the minimum of effort and time from staff and management.

Target aims to assist those designing and forming systems of work so that safety can be in-built as far as possible. A detailed review by safety specialists of causes of accidents showed that the best way to discover latent failures within an organisation was to ask the staff about their working practices and their concerns. The perceptions of staff about safety are closely linked to organisational problems – the "accidents waiting to happen".

After extensive research and trials, 16 Railway Problem Factors (RPFs) were identified (see page 4). Each one can have an adverse impact on safety within the railway. Some of the factors are concerned with workplace conditions while others relate to the processes used.

A method for collecting and analysing information on these 16 RPFs has been developed which forms the core of *Target* ℭ

How does *Target* differ from traditional safety management actions?

Target is an additional safety management tool, not a replacement, but it does have clear differences from traditional methods of safety management.

Target	**Traditional methods**
Planned and proactive	Piecemeal and reactive, ie after an accident – too late
Focuses on system failures	Focus on specific unsafe acts and employ blame-laden terms like"carelessness" and "irresponsibility"
Anticipates and prevents accidents	Tend to 'firefight' the last accident
Seeks staff input	Rely heavily on exhortations and disciplinary sanctions ℭ

How *Target* improves safety – the practice

Where there is an established, effective safety briefing system then *Target* can be put into use with less effort than is required for other methods of data collection. *Target* easily but powerfully supplements existing top-down briefing systems with bottom up staff input. Staff using the system take on ownership with enthusiasm so suggestions for safety improvements are freely given.

Staff are asked on a systematic and regular basis what are their main concerns regarding safety. Data is input direct by staff on to a computer. The program is deliberately written to be very user-friendly. Staff have found it fun to use and appreciate that their views are being requested.

Ideally a computer suite is used where input forms part of a safety briefing programme. Some instant analysis of the data is then possible if required. Alternatively staff can be provided with a portable computer or asked to travel to a central input point.

The results are gathered together and displayed in bar chart form. Analysis can be by comparison with:

- other time periods
- other grades
- other functions and activities
- other geographic areas
- other business units.

Input to *Target* can be made at differing intervals but about every six weeks has proved to be effective and efficient. It is recommended that input is sought from at least 30% of any one staff group to provide statistically significant results.

This highlights areas for further examination followed by corrective action. Typically, two or three factors are identified as in need of urgent attention. These are dealt with by the relevant management and staff. The action being taken should be reported on during subsequent safety briefings. Later staff input will show whether the concerns have been adequately dealt with ○

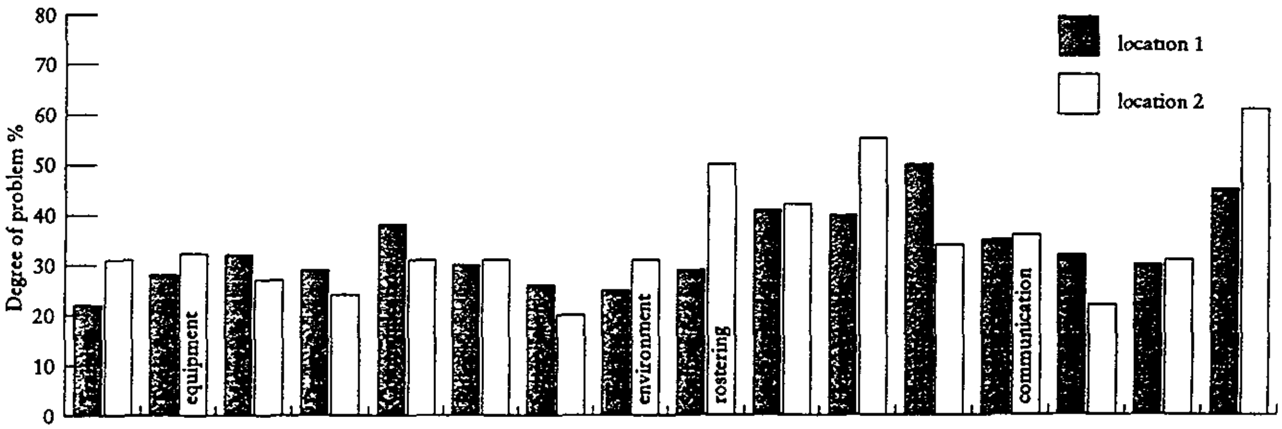
> **"What concerns everyone can only be resolved by everyone."**
>
> **Friedrich Durrenmett**

Railway Problem Factors

The full list of Railway Problem Factors (RPFs) is given below along with example items:

Factor	Examples
Training	Adequacy, quality and frequency of training, refresher courses, information updates
Tools/equipment	Availability of proper tools and equipment and their replacement
Materials	Consumables readily available and adequate re-order procedures
Design	Workplace and equipment design
Communication	Sources of information, notices, working instructions, safety meetings, team briefings
Rules	Rule Book and local rules, clear language, easy to understand and apply, in right amount of detail
Supervision	Attitude of supervisors/managers, interference and contact
Working environment	Working conditions, lighting, heating, eating/drinking/resting facilities
Staffing & rostering	Staff availability, hours worked, shift arrangements, weekend working
Staff attitudes	Job insecurity, negative attitudes, poor relationships, absenteeism
Housekeeping	Vandalism, tidiness, debris
Planning	Meetings, site visits
Departmental communication	Contact and relationship with other departments, level of co-operation
Management	Remoteness, attitude, incompatible goals, impossible demands
Contractors	Attitude, working practices, safety procedures, railway knowledge
Maintenance	Reporting procedures, timeliness, delays, quality

A sample chart of results from two locations



Business A – Signal staff

> "Listing human error as the cause of accidents is about as helpful as listing gravity as the cause of a fall. It may be true but it does not lead to any constructive action."
>
> Trevor Kletz,
> safety engineer

Personal experience of using *Target*

Target is already in use in parts of the railway: here Mick Martin, BRT Territory Operations Manager (North) records his experience and gives his enthusiastic recommendation:

"BRT Territory Operations (North) decided to use *Target*, or Review as it was then called, in mid-1994. We were keen to test the claims made by Railtrack Safety & Standards but did not want to commit ourselves totally. We decided to trial ten sites: three installation groups, three maintenance groups, three office groups and one stores group.

"The initial briefing to managers and safety reps was enthusiastically received. Each group was given a champion to smooth out any problems. In order to set up the system, a certain amount of IT hardware is required. The beauty of *Target* is that it runs on almost anything! For a very modest investment - consisting of buying redundant PCs and looking at what was available in the store room - we were able to set up enough equipment to run the project.

"The results and value in all cases have been good and in some cases outstanding. Because of the blame-free environment created by *Target*, staff have freely identified activities and environments that had major risks associated and had been in that state for years. The software encourages free discussion on safety matters with the local manager and his/her team.

"The claims of the developers have been well met and I would recommend anyone to use it. My only warning is to be prepared to take action, the first time you don't is the last time you will get constructive input from the staff. But the potential benefits are significant. We have improved processes, environments and attitudes through using *Target*. The trial has been so positive that we are introducing the system at all our depots." ○

Target, developed by the railway for the railway

RAILTRACK

Is your organisation using *Target*?

To find out if your organisation is currently using *Target* or investigating its use, contact your Safety Manager. If you or your Safety Manager wants further information on *Target*, please contact Sarah Tozer, Human Factors Analyst, Safety & Standards Directorate, Railtrack PLC, Fitzroy House, 355 Euston Road, London NW1 3AG; *tel: 0171-830 5788; fax: 0171-830 5760*

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Pascale Jost

Adopting the Human-Factor Approach in safety-related Project

Publisher
2000 International Rail Safety Conference

II/4 Pascale Jost

Adopting the Human-Factor Approach in safety-related Projects

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September 1995

Adopting the human-factor approach in safety-related projects

We have found that there are still too many deficiencies.

SNCF develops a lot of safety-related projects : safety of operations, safety of the travelling public and the industry's workforce, safety of goods.

These projects are either geared to engineering (new driving systems, command-control systems, maintenance enhancing tools, man/machine interface, monitoring systems etc...) or to the organisation of work in operating or maintenance functions.

The competence of technical staff in charge of devising and implementing such projects is not to be disputed. However, deficiencies can still be found at the initial stage or operational and maintenance stages of such projects.

These weaknesses can be felt in the overall railway safety-system, on the standard of service delivered to the customer, on the overall cost of projects or in the industrial relations prevailing in the organisation.

When such deficiencies are analysed, they are mainly attributable to an inadequate or late integration of human factor aspects throughout the various development stages of such projects.

The need to enhance and further develop the human-factor approach within projects appears very clearly as a means to attain improved safety-levels (with regard to engineering or organizational aspects) at the initial or subsequent operating and maintenance stages with a view to improving the overall safety performance.

The next question is the following : how to enhance the human-factor approach in safety-related projects ?

The answer is quite straightforward : the competence of project-teams should first be enhanced in the field of human and social science. It is fair to say that , so far, these teams are mainly engineering-led and focused on engineering matters. Then it is essential that the competence gained should be expressed and implemented in the teams in order to enhance industrial relations and possibly the organisation accordingly.

This approach is known as a "social & technical approach" and competence is known as "social & technical" competence. This reflects the need to address the engineering and human or social aspects jointly.

Although the answer to the first question seems obvious, it cannot be implemented easily because it poses additional questions :

- what are the actual tasks connected to the social & technical approach and the action to be taken ?

- Which competence should the project teams have in order to fulfill them ?

- Which structure should be used to implement this competence ?

The human-factor division set up a working party with representatives of various functions so that these issues should be addressed and taken on board by all partners.

The working party is made up of representatives of various engineering divisions which are directly or indirectly concerned with safety responsibilities - Rolling Stock and Traction, Civil Engineering and Property Development, Infrastructure including the Safety Department and the Center for safety-related Research - as well as experts in human-factor and human-resources management - psychologists, ergonomists, experts on work-organisation or training.

Methodology applied by the working party

The working party started their work with the findings mentioned at the beginning of this paper, they focused on the typical way in which projects make progress, looking at each phase in turn - i.e. definition, planning, development, operation and maintenance - thus reviewing action to be taken and questions to be raised with regard to human factors. The group decided whether the actions involved at each stage of the process could or should have been undertaken by the whole project-team or by an external expert.

This enabled the group to identify the field of expertise and the degree of competence required within the project-team.

Let me illustrate this approach by some examples drawn from a non-comprehensive list of some forty actions identified by the group.

1)

Phase	Project definition/stocktaking
Sub-phase	lessons to be drawn following the learning process
Actions e.g.	- focus on the actual situation : strengths to be capitalised upon, errors to be avoided, deficiencies, contributors to risks - gather information as to the social consequences of similar projects -...
Actual requirement	the project team carries out their own actions
Additional skills required e.g.	Field of expertise = feedback : be capable of applying the learning process with the support of data-bases and the information gathered locally -...

2)

Phase	Project definition : feasability study
Sub-phase	Organizational repercussions of the project
Actions e.g.	- Identify specific situations from a risk evaluation and criticality point of view - provisional situations normal or disrupted mode automatic or manual mode transmission of instructions - how various operators communicate - ...
Actual requirement	The project team should at least draw up the specifications in relation to such work and be involved in the process
Additional skills required e.g.	- Field of expertise : ergonomics Be capable of identifying the analyses to be conducted on the mental workload of operators and subsequently analyse the outcome of such analyses - Field of expertise : operational safety Be capable of identifying the critical situations reflecting a human-factor approach (risk evaluation) - ...

The group was thus able to draw up the list of minimum requirements in terms of competence to fulfill the tasks while adopting a human-factors approach. They have been classified in the following way :

- competence related to project management,

- competence related to human factors :

    - knowledge in psychology, sociology, physiology, ergonomics,

    - work-management and organisation,

    - management of human resources,

- competence related to engineering (specially with regard to operational safety),

- competence in the field of communications.

It is worth stressing that the above-mentioned competence relate to various fields of expertise and not only the engineering field of expertise; there is therefore a real need to consider **both** technical and human problems.

Having established the minimum requirements in terms of competence, the specifications for any training to be given to some members of the project-team can be drawn up. This work is currently in hand with the various experts of the fields concerned : i.e. psychologists, ergonomists. etc...

This may also be used by the project-manager as an aid to define the structure or organisation to be put in place within the project-team so as to look after social & technical tasks.

The organizational arrangements may include :

- the designation of a single person in the team in charge of dealing with human-factor related issues, be it personally or through external experts,

- the briefing of all team-technicians in the field of human-factors so that they may identify and flag up those problems which they cannot solve themselves,

- the creation of a structure combining those organizational arrangements,

- ...

The members of the group have considered that it is up to the team-leader to decide which organisation should be put in place in his team in order to take due account of human factors; this decision will be governed by so many criteria including the scope of the project, its strategic implications etc..

In conclusion : principles and validity of this approach

The group was able to define the social & technical competence to be used in projects with a view to achieving the objectives previously assigned.

Simultaneously, the group was able to determine the fundamental elements and challenges involved in the social & technical approach.

The social & technical approach is centered upon the following principles :

- anticipation : the human and social aspects should be reflected as soon as the outset of the project when decisions of a technical and social nature are not fully finalised,

- integration of social and technical competence within the project team in order to address human and social aspects as well as technical and economic issues,

- feedback and review based on an iterative process applied at each stage of the project in order to question engineering decisions when human or social aspects have been carefully considered and vice-versa,

- involvement of potential users (operating and maintenance operators and their line-management).

The purpose of the social & technical approach is aimed at :

- improving the efficiency and reliability of proposed safety-related systems (when saying systems, we include : operator, machine, organisation, physical location and social environment),

- improving the standard of service delivered to our customers,

- a more rigourous control of the overall costs of projects for which we are responsible : costs associated with the definition, planning, operations and maintenance stages.

Consequently, the first action is to make technicians or project-leaders (even project-sponsors) fully aware of the validity of this approach so as to implement it in safety-related projects to a larger extent in the future.

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Terry Worrall

Railway Operations- Alcohol and Drugs The risk and how to control it

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2000 International Rail Safety Conference

II/5 Terry Worrall

Railway Operation
Alcohol and Drugs - the Risk and how to control it

INTERNATIONAL RAILWAY SAFETY CONFERENCE
MAINZ
10TH-12TH OCTOBER 1995

"RAILWAY OPERATION ALCOHOL AND DRUGS - THE RISK AND HOW TO CONTROL IT"

Presentation : TERRY WORRALL
Director Safety
British Railways Board

RAILWAY OPERATION

ALCOHOL AND DRUGS - THE RISK AND HOW TO CONTROL IT

Before I begin my main presentation I would like to give a very brief update on the organisational elements of the UK Railway Industry which is being privatised. Last year I presented the picture as it was then This is as it is now.

Not much change you may say if any of you remember the picture last year

That is true although a number of the smaller BR companies have been sold and we are down from 83 to 73 However, Railtrack are moving closer to flotation on the Stock Market - some time in 1996 and a number of the BR Train Operating Companies are closer to actual sale or in the case of Passenger companies, franchising By April 1996, the Government are confident that 3 passenger franchises will have been let and that the 3 main Freight Companies will have been sold. There we are then - my role has not changed during the last year, nor will it during the next.

Now on to the main presentation

Objective of Presentation

My objective today is to present to you the way in which the Alcohol & Drug issues are currently dealt within the UK Railway industry, highlighting the background to the Policy, outlining problems with application, detailing results to date and indicating potential enhancements for the future.

This presentation and paper is based on operational practice but acknowledging the medical opinion and advice received, is largely from an operational perspective. At the outset I ought to recognise that some delegates here are from a generation which has not been exposed to drugs - no doubt many of us have been exposed to alcohol, some more than others, but the drugs scene appears to have it roots in the 1960's "free expression" and liberalisation period - with its more widespread effects being felt societally from the early 1970's onward to the current position where drug abuse is regarded as being of "epic proportions" in many countries.
A personal indication as to its widespread effect and a means of comparison between generations derives from the fact that I have never personally been exposed to any offer of drugs, other than those medically prescribed, nor knowingly been in the company of anyone taking drugs but my daughter was first approached when she was 15 years of age at a party with people of a similar age group in 1990 - that is the type of scenario we face and it is getting worse.

Society Risks

BR were aware of, but perhaps not in sufficient detail, of the ever increasing use of drugs in society. Internally there was evidence that BR was not immune from this problem - this not being surprising as we employ staff from all walks of life and from all communities within the UK.

In fact BR could be seen to be a microcosm of British society Government publicity has recently increased the concern and heightened awareness on the basis that :-

The Problem

- Cannabis accounts for the largest volume of seizures - to a lesser extent this is followed by amphetamines, cocaine and heroin.
- On average every day there are 200 ceasures of illegal drugs by Police or Customs authorities
- In 1994 there were 28,000 drug addicts registered in the UK (thought to be rising by 10% per annum)
- In 1992 there were over 1400 drug related deaths
- 6% of the population (about 2 million people) take an illegal drug at varying frequencies

The Railways operate of course within the community and their employees are effected by the cultural scene and by societal events and practices.

Whilst the effects of alcohol are more evident, often in behavioural terms, these effects are more often overcome in a much shorter period, other than in the case of severe alcoholics who might well be under the influence for much of the time

The drugs position is clearly quite different - drug takers are often on a short term "highs" but more frequent users can be under the residual effects of drugs for a very long time if not permanently. Casual users might well take some forms of drug on a sporadic basis but, dependent upon the drug, the effects can go on for days, possibly weeks, even after one intake

UK Law is similar but not the same to some elements of European Community and International Law which refers to lists of "controlled drugs" - these being substances which are illegal other than when prescribed for medical purposes - some drugs have no legal use and are statutorily proscribed.

The Railway industry in the UK has long since recognised the problems with alcohol and Railway rules have banned both reporting for duty under the influence of drink or consuming intoxicated liquor for as long as I can remember and beyond The BR Rule Book in 1950 stated this clearly as seen here.

Supervisors and managers have long since been alert to the behavioural traits of persons under the influence of alcohol and generally speaking the policy for dealing with people who have offended has been well defined and well executed within the industry

The reasons for taking a firm disciplinary line should be obvious - everyone in the operational Railway and in backup functions on the engineering side works in a safety critical environment where not only is their own personal safety at risk but the safety of colleagues who may work along side

Work undertaken under the influence of alcohol or drugs will undoubtedly be substandard with very significant adverse effects on train operation and customers - there is clear evidence to this effect.

There have been 3 accidents in the UK in the last 5 years attributable to drivers being under the influence of either alcohol or drugs - at Maidstone, Tattenham Corner and Cannon Street, about which I will say more later Here are 2 views of the consequences Fortunately no one was killed or injured in the first 2 accidents but as is often the case it is only a question of luck or pure chance

Within the UK the focus remained on alcohol as a potential problem for many years with robust procedures, already mentioned, to manage both the individuals concerned and the effect - usually in a disciplinary fashion

As time moved on more information became available and gradually the issues associated with drugs became more evident - this resulted in an enhancement to the BR Rule Book in 1989. almost 40 years after the previous Rule alteration, to the effect that employees should not report for duty under the influence of intoxicating liquor (i.e as before) or any drug which might impair the proper performance of his duties

In addition an enhanced "Alcohol and Drugs" policy was introduced in 1991 but I have to say with hind sight it was not briefed or introduced in a very professional way and some of its planned effects were never realised

In 1989 the BR Occupational Health service conducted an anonymous drug screening exercise using urine samples from staff who were attending for routine medical Names were not recorded but activity groupings were. The test was undertaken in specific areas of the United Kingdom to determine the extent to which, if at all, drugs were a problem and if so whether or not there was any marked geographical or demographic profile.

The results clearly indicated that the industry faced a bigger problem than it had anticipated and there was evidence in some specific activity and age groupings of higher use than in others

At the same time the concept of "safety related posts" was introduced into the Railway and an attempt made to relate the rules and procedures associated with drug screening to persons occupying "safety related posts".

During 1991 BR introduced pre employment drug screening for all new entrants and screening for persons either in, or aspiring to be in, "safety related posts" on promotion or transfer. No monitoring system was established to determine the effectiveness of this change

Referring now to the accident at Cannon Street mentioned earlier - this watershed event occurred in January 1991 when a fully laden passenger train collided with the buffer stops at Cannon Street Station in the City of London during the morning peak period As a consequence two persons died and 577 were injured

Suspicions on the day and subsequent inquiries indicated that the driver was a cannabis user and that the failure on his part to proper regulate the stopping of his train, which was in a satisfactory technical and operational condition, bore signs of the possible side effects of cannabis Regular users of soft drugs such as cannabis can for many weeks after ingestion, suffer hallucinatory effects and lapses of concentration Whilst not proven during the course of the subsequent Accident Inquiry, both internal and Public, there remained a suspicion that this was a significant causal factor in the course of this accident

This was a high profile accident, happening in the centre of the capital city, and attracted much political attention and media comment.

The Safety Regulatory body the Health & Safety Executive in the form of Her Majesty's Railway Inspectorate had been concerned about a number of statutory deficiencies in the regulatory system for Railways for some years

As a consequence of both the Cannon Street accident and their strengthened concern the Transport & Works Act 1992 emerged from the legislative machine in December of that year placing additional responsibilities on Railway Management and staff.

Transport & Works Act 1992

The Transport & Works Act defined the legal limit of alcohol as being 80 milligrams per 100 millilitres of blood - the same as the Road Traffic Act limit for driving road vehicles in the UK

Section 27 of the Act is fairly self evident and defines specifically the activity groupings principally involved Section 28 clearly outlines that an offence would also have been committed by an operator unless it can be proven that the responsible operator has exercised all "due diligence" to prevent the commission of such an offence on the transport system

The BR Board determined that they would go for a lower limit within their policy and that a reading 30 mg/100 ml would be their "cut-off" level Any readings of alcohol of 30 or above would normally lead to dismissal - any reading of 80 and above would always lead to dismissal and possible criminal proceedings. These more penal levels were the subject of criticism but it is interesting to note that other countries may eventually move the acceptable levels more towards the position the BR Board adopted in 1993 certainly as far as Road Traffic Laws are concerned Although there are now strict laws in the USA and in some States in Australia I am unaware of any equivalent legislation applicable to Railway operation insofar as alcohol and drugs are concerned in other parts of Europe.

Clearly from a customer point of view the BR Board needed to be seen to adopt a serious view on alcohol and drugs particularly in the light of the evidence and the accidents that had occurred

These limits remain in the current policy and are unlikely to be altered

As a consequence in BR the alcohol and drugs policy was radically overhauled and a completely new package was prepared for introduction in October 1993.

Whilst a policy of this sort, involving checks and screening, can be seen as a threat by the staff, an opportunity was taken at the same time of introducing, more formally, a "rehabilitation" opportunity - the rehabilitation policy being in built into the Alcohol & Drugs policy

The principle behind this was that if any individual recognised that they had a problem with either alcohol or drug dependency, the could declare it prior to being "found out" or being involved with an accident or incident and would then be given an opportunity to be rehabilitated through a prescribed process with the Occupational Health service and possibly involving external parties as well with counselling etc

The consequence of voluntarily revealing a dependency problem would undoubtedly lead to individuals being removed from a safety critical post - individuals would need to understand the consequences but if successfully rehabilitated they would not lose their job and in due course may even be returned to the job from which they had been removed

Experience to date has shown that 0 2% of the BR work force have asked for help and this has been provided Of those numbers receiving treatment 60% successfully recovered and returned to their previous employment

As part of the treatment each individual is subjected to post treatment screening for a period of one year. The 40% who failed to complete the treatment left the industry - in this way they represent no further risk to our industry but one has to accept they possibly represent a risk to both themselves and others for whom they may work in future

I now move onto more detail with regard to the detail of the Alcohol & Drug policy which has been encapsulated within a Railway Group Standard Group Standards are managed and owned by the Railtrack Safety & Standards Directorate - Railway Group Standards are mandatory and all companies who are designated as Train Operators and who have a licence from the Regulator to operate on Railtrack's infrastructure are required to abide by the policy outlined in the Railway Group Standards.

Screening

Pre Employment

All candidates selected for employment are screened for drugs as part of their pre employment medical Where drugs are found to be present or if candidates refuse to be tested they are rejected Applicants who test positive may not be reconsidered for employment for three years after the test Currently about 2% of applicants across the country fail this drugs test As a contrast you may wish to note that in New York in 1992 60% of applicants for jobs on the railway tested "positive".

Promotion & Transfer

All employees selected for transfer or promotion to Safety Critical posts - safety critical being a re-designation of safety related, about which I will say more later, are tested for drugs before any training is carried out and any promotion is confirmed Employees who test positive or refuse to be screened are not appointed and are liable to disciplinary action resulting in dismissal Currently 0 3% fail the drugs test.

For Cause Testing

There are two types of "for cause" testing - Post incident screening and for behavioural reasons

After a serious or potentially dangerous occurrence which resulted or could have resulted in death, injury or substantial damage to equipment or property, post incident testing for alcohol and drugs may be carried out if there are reasonable grounds to suspect that the actions or omissions of any employee, whether safety critical or not, contributed to the course or cause of the incident The line manager makes arrangements for a contracted screening company to attend immediately Currently 2 4% fail the alcohol or drugs test in these circumstances

Whenever an employee's behaviour gives rise to suspicion that they maybe unfit for duty due to alcohol or drugs, for instance when presenting themselves for signing on duty, the manager or supervisor will remove him or her from duty and arrange for an alcohol and drugs test Currently 49% of staff who are potentially identified as "suspicious" fail the alcohol or drugs test - this a further measure of the education of supervisors and managers in the front line to identify potential factors and traits associated with alcohol and/or drug abuse

Unannounced Screening

Unannounced screening was one of the more significant parts of the October 93 Policy The target was for 0.5% of all staff in safety critical posts to be screened on an unannounced basis each year. The number of staff working for BR at that time meant that about 5,000 tests would be undertaken per annum. Employees are selected randomly using computerised payroll numbers, not names. They are then identified by name at depot level in order to attend a local medical centre for screening and given a maximum of 48 hours notice, but no less than 24 hours, of their appointment. They may return to duty whilst waiting the outcome of the drug test Currently 0.36% fail the drugs test

The Screening Process

Critical to Trade Union support was the integrity of the screening process and in particular the integrity of the process for custody of specimens and samples

A process referred to as "chain of custody" was introduced which is a legally defensible system of controls which documents the progress of a specimen from the point of collection to the reporting of results It is designed to link the specimen to the donor and the analytical results to the specimen Trained collecting officers from BR's contracted firm identify the donor, collect the specimen, transfer the sample to a container, label and seal the container and obtain the donor's signature as authority for the specimen to be tested The container is then despatched a sealed package to the testing laboratory. Laboratory staff analyse the sample and report back to BR's Occupational Health Service - more recently a privatised company Here a medical review process is undertaken in conjunction with the laboratory to ensure that any positive results arising from genuine medication are eliminated.

By genuine medication we mean that which has been prescribed for a medical condition by a Medical Practitioner - questions to this effect are asked immediately prior to the screening process Line managers are then advised of positive results only and initiate disciplinary action which normally leads to dismissal

The "chain of custody" process as so far proved to be robust, in that all challenges to positive results have failed In the case of positive results, part of the original urine sample is retained for one year in case the donor request reanalysis

In spite of all the support and the generally shared objectives of such a policy there has been reaction and non acceptance by some staff who believe that the policy affects their civil liberties and their personal rights - in particular that it affects their social life and prevents them from engaging in social activity at certain times particularly in the case with staff who work changing or rotating shift patterns

Obviously the message to staff suggests that it is far better and much safer if no alcohol or drugs are taken and the education process towards this end continues.

Staff taking medically prescribed drugs are encouraged and required to explain to their Doctor the nature of their work and if there is any doubt as to the extent to which any particular drug could contribute to a lower level of job performance affecting safety the individual is required to see his Line Manager and the Company Doctor in order that the necessary professional advice can be given

Consultation

As mentioned earlier a robust consultation and briefing process was undertaken prior to the formulation and introduction of this policy. Foremost in the consultation process were the Trade Unions who are supportive of the policy objectives.

Introduction of this new and revised policy was briefed to every single member of BR staff - a significant improvement on the arrangements that had applied with previous policies.

A video was prepared together with supporting publicity material including pocket sized reminder cards - following the briefing individuals had no excuse whatsoever for offending against the policy

Briefing of staff was essential in order that each member of the staff understood the effects of alcohol and drugs and in particular where alcohol was concerned the level of alcohol that was within "limits".

All information continues to be shared with the Trade Unions, other than for personal details as we are now undertaking a review of the policy to determine its efficacy and considering possible enhancements for the future.

Application of Policy

Whilst a policy can be supported by Trade Unions and in general by the staff, albeit with some reservations it can always be undermined by the problems associated with implementation and application - particularly in a large business with many thousands of staff operating in many different parts of the country. BR were not immune to this effect and during implementation and subsequently during application of the policy there have been many nonsenses. Clearly two areas have been identified as representing a potential for eroding the integrity and credibility of the policy

For instance where trains hits trespassers when more often than not it is wholly inappropriate to automatically test the train driver for drink or drugs - this is an unforeseen situation which arises at random in terms of time and location Unless there are suspicions on the part of a supervisor or other person called to the scene, guidance has been given that there should be no automatic testing.

Other examples concern incidents or accidents where personnel from more than one company may be involved - in the case of derailment staff may ask why is the driver always tested and not the signalman or shunter An example of a nonsense perpetrated earlier in the implementation phase relates to a situation on a station platform. A train was stationery in the platform with the driver at the controls. Passengers were boarding An electrically powered station trolley was being driven along the platform by the operator delivering catering supplies to another train. During the course of this trolley movement the operator lost control and collided with the side of the train The train driver was sent for testing but not the trolley operator!

Monitoring and Evaluation of Policy

Having introduced such a radical policy involving 10's of thousands of staff there was an obvious need to monitor the effects, the results and the application elements. This was done with a view to determine whether or not more intelligent targeting of activity groupings or geographical areas might be appropriate

The overall results for the first year are shown here

The more recent six months results from October 1994 to March 1995 are shown here Furthermore, these results will be reviewed as part of the overall policy review to determine the extent to which the Railway Group Standard needs to be modified - It is likely to be modified at some future date addressing the policy at a higher level leaving individual companies to work within the law and to take account of "good practice" - recognising that private Train Operating Companies will be called upon to demonstrate that they have exercised "due diligence" in pursuance of their preventive policy for alcohol and drugs It is unlikely that any company will change the existing arrangement lightly but it must always be recognised that there may be more effective measures as we gain experience.

Currently both BR and Railtrack are working together to review the policy with a, using results which are available from the first 18 months, almost two years now. Together with the Trade Unions we will be looking at possible enhancements e.g. random alcohol testing. Random alcohol testing is already used in Australia and in the USA The means by which this can be done and the secondary risks which it presents are being considered by BR currently.

Benefits to the Industry

In terms of benefits there are 2 dimensions:- personal health and company liability Individuals are now more aware of the health risks associated with abuse and a further health campaign is planned. Recognising the threat to their job security staff are more prudent about their personal habits. We would of course wish them to accord with the Policy because they really want to rather than because they were concerned about the possible consequences in terms of their job.

Since the policy was implemented BR have suffered fewer employee fatalities Notably the number of track staff deaths has fallen to single numbers Although there was little testing until recently there is no evidence that track deaths in previous years were in anyway related to alcohol or drugs there must always be a suspicion that some of them may have been. We believe the Alcohol and Drugs initiative has had a significant and beneficial on safety performance and has reduced losses both in terms of people and equipment It can also be stated that some element of employee lost time accidents, which have reduced, must be attributable to this policy although that is always difficult to substantiate. I have mentioned accidents which have been clearly attributable to drink or drugs - clearly to remove this possibility or at least reduce the likelihood must also be of benefit to the customer and the well being of the Businesses. A safe business is a good business is a maxim that may well be taken to heart. I recognise here that infinite amounts of money are not available for safety - other speakers at the Conference are addressing the calculation of safety benefits and prioritisation of expenditure on the risk based approach - some initiatives have a good safety payback at relatively low cost - I believe that our Alcohol & Drugs policy falls into that category.

The Future

As most of you will be aware the UK Rail industry and BR as previously designated is breaking up in the manner described earlier.

I believe that the policies drawn up and implemented effectively by BR and in more times jointly by BR and Railtrack will be carried forward into the newly fragmented organisation and engaged, possibly with beneficial enhancements, by the privatised companies At the end of the day it has to be recognised that each individual company, whilst according with the mandatory Railway Group Standard will have the flexibility to implement their own policies but in manner which allows them to demonstrate one way or another that they have accorded with the Law. Work in recent years, insofar as alcohol and drugs is concerned, by both BR and Railtrack is a considerable contribution towards the privatised companies being able to demonstrate this in a Railway operational scenario. The work to consider enhancements and improvements continues

Conclusion

BR and Railtrack, currently the UK Railway group, can demonstrate that they have together taken a proactive stance in order to reduce loss through alcohol and drug abuse A policy has been introduced which must be regarded as balanced and which, 2 years on, is part of the accepted Railway practice, certainly by the vast majority of people involved in Railway operations. Losses have been reduced, staff are reorganising their social activities, help is available for those in need and changes are under consideration for identifying policy enhancements. I believe that BR, together with other colleagues, has established a cost effective approach to addressing the problems of alcohol and drug abuse and commend a similar, if not the same, course of action for other Railways in order to recognise and combat the difficulties brought about by alcohol and drug abuse, particularly the potentially "hidden" effects associated with the more insidious nature of drugs.

If any Railway companies represented here would wish to obtain more detail of the policies about which I have spoken I will be only too pleased to share the detail with them I would also like to learn more of any other companies' approach to this subject area..

Thank you very much for your attention.

END

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Jean-Bernard Benech

Use of Cognitive Competence by the Railway's Operators modelling and training issues

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Use of cognitive Competence by the Railway's Operators modelling and training issuses

USE OF COGNITIVE COMPETENCE BY THE RAILWAY'S OPERATORS MODELLING AND TRAINING ISSUES

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Summary

Although knowledge has been acquired at some stage and subsequently memorized, it is not always used when it should be or in the appropriate form. SNCF experts have conducted an analysis of railway safety-critical events in order to establish when operators have failed to mobilize the required knowledge or competences, as a decision-aid for training, with the objective of preventing such failures.

A model for the processing of information and analysis of behaviours on the work-place has been used to investigate the types of possible rationale and failures, so as to reflect the railway-specific features whilst improving its performance against efficiency-objectives.

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More than ever, emphasis should be placed on the human component of system reliability. Human beings' professional expertise and their capacity to anticipate enable them to identify, understand and act when regularly faced with a variety of working situations. The company's resources are changing rapidly, requiring more flexibility in order to meet various constraints. The efficiency of the railway system and the standard of service delivered are not only dependent on technical achievements but primarily constrained by the economic and social environment, the relations with the outside world and the in-depth knowledge on human beings in working situations

Railway control is not only based on the implementation of memorized knowledge, it also means calling upon theoretical references, practical knowledge and conducting an appropriate analysis of the particular aspects of a given situation in a sometimes limited period of time

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All relevant knowledge is mobilized by every player in order to contribute to the objective pursued by all. This is backed-up by the professional experience gained by every operator but competence remains strongly related to the context under consideration. Human beings act on the basis of stable references and deep beliefs which become gradually anchored. Poorly defined changes, rigid organisational arrangements or ineffective coordination may affect performance unfavourably It is therefore up to company management to understand the relevant mechanisms or circumstances accounting for the difficulties encountered so as to take the appropriate decisions in technical, organizational or training terms .

1 - STOCK-TAKING

SNCF has collated and analysed actual events and circumstances in which the railway system was found to be vulnerable. A multi-disciplinary data-base was thus set up, including more than a thousand cases so far. A team of experts from the various railway disciplines and social science have worked closely together in order to characterize the precursors, the chronology and the sequence of significant events resulting in incidents, with two objectives in mind · understanding the actual difficulties and failures against the overall functional background and trying to quantify their impact upon the overall safety performance.

The following lessons can be drawn ·

- operators are directly involved when one considers the preliminary signs of disruptions leading to critical events and this is is true in 62 per cent of instances,

- incidents affect all activities, jobs and categories of operators,

- minor acts and ususal tasks are mostly the underlying reasons,

- there is little evidence of a lack of theoretical references which happens to be enhanced throughout the professional life of operators, however the latter are found not to be quite comfortable when they want to mobilize and use such knowledge in the face of specific situations or problems,

- nevertheless, the need for resumed training seems to be advocated by many local managers as a means to prevent such events from occuring again

These findings are derived from a systematic and thorough analysis of information-processing in real-time and of the way operators come to grips with situations identified as uneasy. It was thus felt necessary to focus on the interplay between knowledge, competence and ongoing training.

1.1 - Need for a more thorough investigation into the theoretical aspects

Traditionally, the memorization capabilities of operators have been used as references in order to define the positions and abilities required to carry out the relevant activities, gradually leading to a confusion between the competence and memorization capabilities required; the applicants were thus expected to give "THE" answer to a specific problem. Then, the requirements for RAMS and the use of new techniques emerged, requiring a more flexible and dynamic approach to be taken into the cognitive aspects. It thus became obvious that human behaviour had to be analysed in working situations while allowing for the underlying psychophysiological and cognitive components.

This gave rise to a range of methods : the use of *fault trees and event trees* to represent facts, the *interactive models* with the effect of failures on decisions and attitudes, the *systems approach* with the influence of the environment upon the way in which human beings process the items of information perceived, the *impact of the hazard* perceived and *how to counter it* (SURRY model) and more recently the analysis of *the appropriate time and nature of the action* to be conducted by the operator (HALE AND GLENDON model).

1.2 - Building up more precise knowledge about human beings performing professional activities

An improved understanding was achieved through the pooling of knowledge about the technicalities of railway jobs and situations as well a detailed examination of human factor aspects. The Center for Safety Studies of the French Railways thus created a **model** (see Revue Générale des Chemins de Fer, June 1993) aimed at **analysing** the relation between the actual event and the individual involved. The model describes the information-processing activity and the mental input involved. It is based on the behavioural and reasoning patterns of people at work, on their perception of the environment, on the identification of hazards and priorities in relation to the railway system Human failures are analysed as to their type, causation factor(s) and stage in the information-processing sequence and they are examined from the point of view of skills, rules or knowledge. This has led to the following findings :

- weaknesses in behavioural patterns are attributable to skills and the introduction of additional procedures is of little avail in this respect,
- each job-category is characterised by its own weaknesses in the use of knowledge and abilities,
- professional activities are performed while risks may be incurred at any time on the running railway, which entails additional difficulties in so far as the operators tend to focus on their tasks and overlook their complex working environment.

The obvious question is · **How does competence come into play ?**

Researchers were called upon in order to give an answer to this specific question. A cooperation agreement was thus signed with the Corom consultants.

2 - MODEL FOR COGNITIVE COMPETENCE

2.1 - Fundamental references and benchmarks

Competence may be viewed as the ability to overcome problems in a given working environment, which implies some common ground between the competence and problem-solving strategy concepts.

We have therefore identified the so-called "cognitive competence" which gives us guidance and helps us prepare our action. Cognitive competence is not to be confused with knowledge, know-how or attitudes but *enables us to mobilize* the relevant knowledge, know-how and attitudes.

Cognitive competence can be further characterised by the following features :

- it is developed and enhanced through action and experience and can hardly be taught in an academic fashion,
- it goes hand in hand with the action undertaken; the intellectual approach cannot be distinguished from the knowledge, know-how,and behaviour and stable references brought into play,
- the operator mobilizing such a competence is seldomly aware of it and it is therefore difficult for him/her to express such a message or convey it for someone else's benefit.

This causes significant training difficulties, especially when conventional training techniques are used, which are in essence isolated from real action. Training is indeed focused on knowledge, know-how and behaviour but *the "acquisition of the proper cognitive competence"* is not guaranteed as an added benefit even though the problem does not lie in basic competence but *in the way to mobilize it.*

Since cognitive competence is also linked to real *action*, an **overall cognitive structure** will take shape; it can be defined as a combination of sufficiently inter-related cognitive competence giving rise to a stable structure further broken down into : the prevailing intellectual approach, the relation to time and space, the interpersonal relations and the level of knowledge and stable references.

- The *intellectual approach* (IA) can be defined as a sequence of mental actions leading to the solution of a problem. It includes the following concepts : a logic, ways how to set about things, a guide, directions for use, a method for action and problem-solving.
- The *relation to time and space* (RTS) has to do with the relation between the relevant space and problem at stake, with the number of components and their time of occurrence to be reflected at the problem-solving stage and finally, with the varying nature of information to be processed. Whilst acting, does the operator integrate the particulars of his environment there and then or does he/she take a wider approach ? what time-constraints are reflected in the process ?
- The *interpersonal relation* (IR) has to do with the type and nature of input required for problems to be solved in a given professional activity. It is characterised by two indicators frequency of occurrence and nature "next to", "alongside with", "against" .)
- The *level of stable references* (SR) is in effect the basic library enabling the operator to understand, act and learn in his/her job. They provide the stable structure of support-knowledge, on which the rationale will be based, supplemented by further concepts in the light of experience.

The term "**structure**" is being used on the assumption that the outcome becomes robust, permanent and is progressively independent from action. Independence prevails because the structure is attached to the individual rather than to the situation.

Backed up by his/her experience and as long as such experience-stages call upon similar cognitive competence, individuals will build up their own internal structure and call upon it, irrespective of circumstances

Then comes a time when the problem posed is of a different nature but the individual tends to solve it with the support of his overall cognitive structure even if the latter is no longer adequate, in view of the actual circumstances It will be even more difficult for the operator to act in a different way when the overall context remains broadly the same.

These fundamental patterns are so deeply anchored that people will not adapt immediately when they take on a new job but they act in accordance with their habits and will in fact "resist" mentally and unconsciously all the more so as change will not be so obvious as to enable realization. These phenomena are even more pronounced when the "relation to time and space" criterion is significant.

2.2 - Setting up a new dynamic model : the SRK model

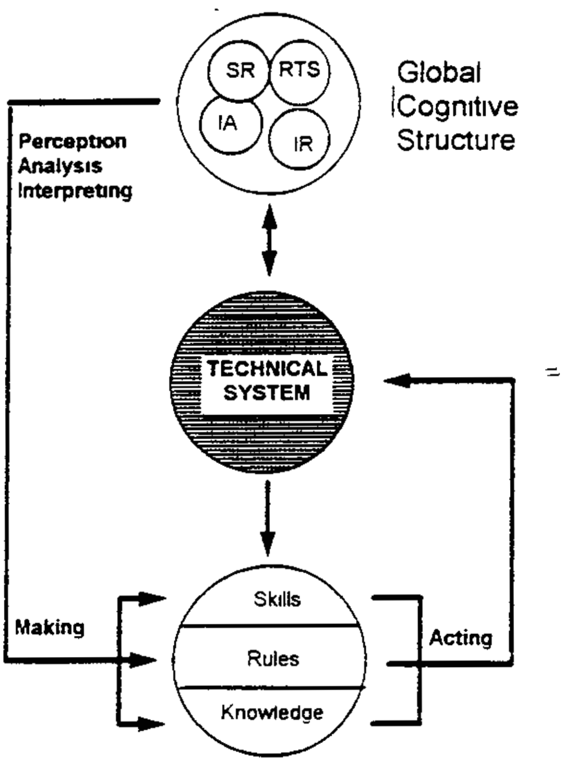
Link between the mental input and the way the overall cognitive structure comes into play

According to RASMUSSEN, experience teaches individuals to act according to skills, rules or knowledge; the intellectual approach will systematically mobilize the skills, rules or the knowledge (known as SRK), although the proper level might not be mobilized in a given situation. At this stage the *difficulty for an individual not to call upon a dominant mode* may account for some human reliability failures

Cognitive competence as defined should not be confused with skills or specific rules, as defined. They lie "at a higher and more abstract level", i.e. in the *unconscious mental framework* where rules and skills are implemented

Operators will naturally call upon various levels in the SRK model when faced with real situations. SRK could be likened to the first level of competence and rather than referring to the conventional concepts of knowledge/know-how/behaviour, mention should be made of the SRK which are the end-result translated in cognitive terms.

IN SUMMARY, HUMAN BEINGS DEAL WITH A GIVEN SITUATION ACCORDING TO THE INTERACTIVE MODE EXPLAINED BELOW



Diagrammatic representation of the overall cognitive structure in familiar situations

- in a given situation, human beings call upon the cognitive resources (known as GCS) governed by four main criteria : the relation to time and space, the interpersonal relations, the level of knowledge and references and the prevailing intellectual approach,
- resources enable them to perceive, interpret and decide to implement solutions, with the appropriate mental input (which calls upon SRK, i.e. skills, rules or knowledge). Once initiated, the action has an influence on the status of the system in which the individual has a part to play,
- system change is addressed by the operator who mobilizes his/her cognitive resources (GCS) and mental input (SRK) in a different fashion.

The *mental input model* (SRK model) is closely related to a given situation, notably to situations of operating incidents. It does not fully clarify the dominant and habitual behaviour of an individual nor the building up of competence

The *cognitive competence model* (GCS) has more to do with the cognitive patterns generally, in a familiar situation and with a dominant mode : it is not adequate to fully account for incidents.

Therefore the combined use of both models help us understand what actually happened during the incident (SRK model) and why the operator did not take the right approach (GCS model).

Once the dominant cognitive model has been identified as well as the way in which the operator called upon his cognitive resources in the critical situation, the reasons why he/she did not actually implement the proper resource can be found. The use of the SRK model highlights the difference between what actually happened and what should have happened.

Two levels can already be identified if we try to illustrate the behavioural process resulting in such a failure :

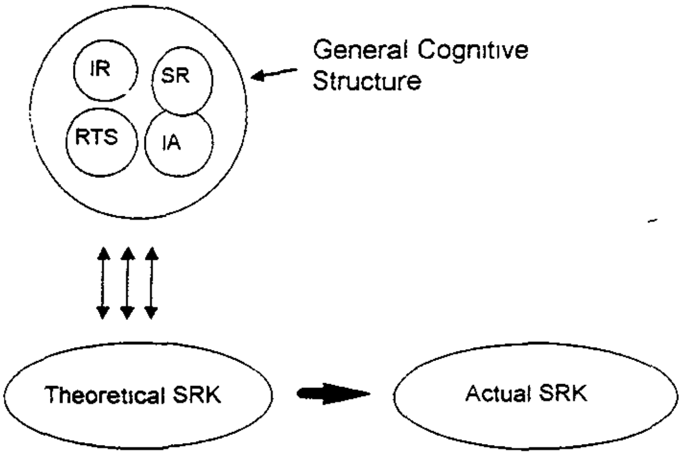
- either the problem lies in the *mental framework* (*overall cognitive structure/GCS*) so as to grasp and analyse the status of the system,

- or it lies in *the way in which solutions* - skills, rules or knowledge (SRK) - *are implemented* for problems to be solved.

2.3 - Training implications

What happens when incidents are mismanaged or not properly solved or unsolved ? in other words, why are the arrows between the GCS and the SRK ineffective either directly or through system analysis ?

This diagram enables us to identify two alternative operator's behaviour, with varying training implications :



- when the theoretical SRK level is not consistent with the nature of the GCS, the operator is in a situation whereby his GCS is not consistent with the theoretical pattern; **organisational arrangements** play an important part in such a case,

- when the actual SRK level is not consistent with the nature of the GCS but when the latter is consistent with the expected theoretical level, a **change in the operator's behaviour** might enable him to mobilize his/her competence.

The disturbance in the cognitive behaviours is related to the change in information scope The information scope is thus reduced.

The information scope is taken to be the system as perceived and interpreted by means of the mental framework. The scope can be viewed as the structuring of information resulting from the interplay between the **system** and the individual. The scope is dependent upon all system-information, their display and the operator's psychology. The failure in the process may occur at various stages . perception, analysis, interpreting, problem-solving, decision.

Most incident scenarios recorded in the incident library show that the operator seeks to *simplify* a situation which suddenly becomes too complicated to be handled with the restricted means usually implemented, because problems or unexpected events have arisen In the remaining cases, the overall context plays a more important part.

3 - OUTCOME OF ANALYSIS AND POTENTIAL IMPROVEMENTS

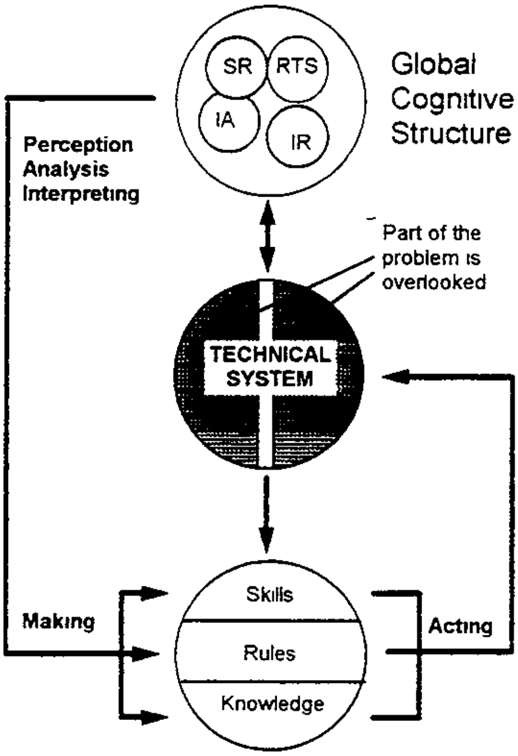
Based on the range of possible scenarios in each job, some training options may be recommended as well as the objectives, the possible resources to be implemented and suitable teaching techniques. Let us look at the scenarios and training options available.

3.1 - Focusing

Focusing means that the operator is focusing on some components of the problem as if the whole system were viewed through a cone. Consequently, the operator cannot process the objective data in relation to the situation and restricts his mental input. Focusing can be twofold :

- it can either affect the detection capabilities and part of the system will just « not be seen »,

- or it occurs at the analysis stage prior to action; the operator considers that part of the problem can be overlooked



FOCUSING

New training options can be considered, reflecting the overall cognitive structure

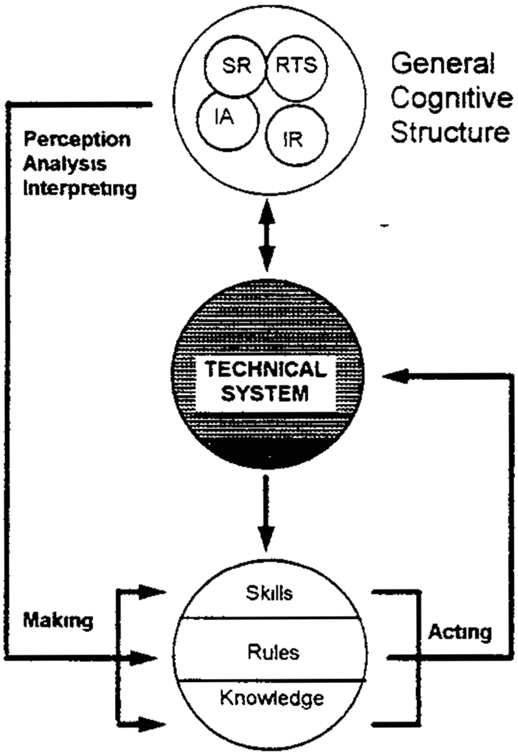
MAIN OBJECTIVES	RESOURCES TO BE USED
- Develop an **overall approach** track/engine/environment - Ensure system component is reflected in decision-making	- **Scenario analysis** based focusing, - Simulator exercices with varying and contradictory promptings, - Training for the detection of focusing failures job, with a trainer, - Series of cases

The teaching techniques should aim at increasing operators' awareness through memorization, training under supervision, enlarged information-scope and increased number of parameters to be reflected in the decision-making process

3.2 - Fragmentation

Fragmentation means that the whole system is addressed at a given point in time but organisational arrangements are such that the system is viewed as simplified on account of the number of individual tasks to be performed. This is mainly attributable to two causes : time-pressure and focusing on the target.

Under the pressure of time, work is subdivided into sub-objectives with prioritisation. The linkage and the possibility to anticipate from one task to the next is lost in the process. When people want to solve one aspect of the problem at all costs, they are also led to a partial solution which may be inadequate with reference to the situation as a whole.



Fragmentation

The system is viewed as a succession of stages and the next steps(s) in the process is/are not anticipated strategy applicable to the situation The cognitive input is only related to the status of the system as perceived.

As in the previous instance, **new training options can be considered, reflecting the overall cognitive structure.**

MAIN OBJECTIVES	RESOURCES TO BE USED
Make the decision/ action/control over system process more effective	- Case analysis, - Training for work preparation with decision/action in new & disrupted situations, - Exchange on past experience of people (*)

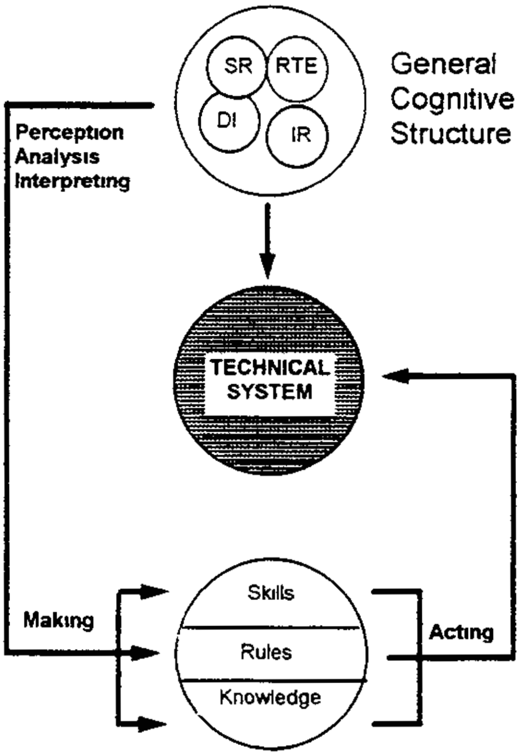
(*) organisational arrangements for teamwork (in the depot, on the track), getting mentally ready to start work...

Active teaching techniques are recommended with table-top exercises on pre-work briefing, route-setting, case analysis, radio communications.

3.3. No scanning

The operator sees the system according to his usual practice and does not deem it necessary to check some items which generally have not posed problems according to his/her experience.

The action is initiated but there is no direct link between the mental input (SRK) and the actual situation. In some instances, the skills, the "normal" and vital procedures have been set aside and replaced by another level of mental input. The latter level is not safety-compliant but more likely to speed up work, make organisational steps easier and alleviate perceived fatigue



No Scanning

New training options can be considered, reflecting the overall cognitive structure.

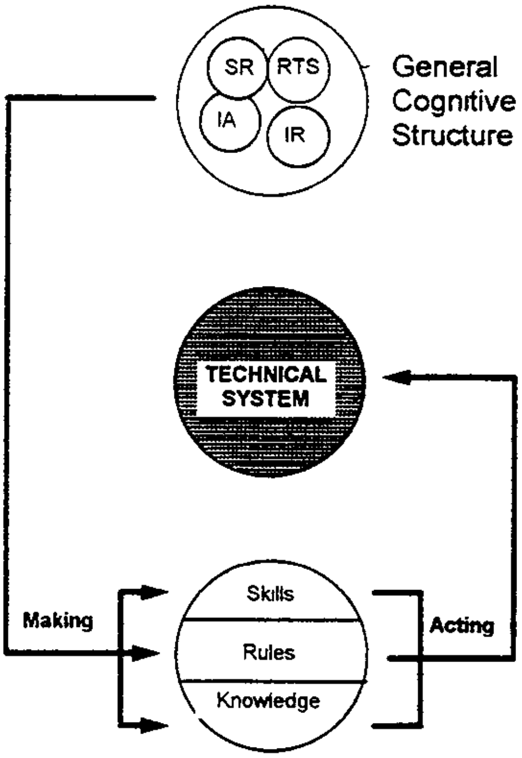
MAIN OBJECTIVES	RESOURCES TO BE USED
- Develop a habit of professional cheks - Develop self-check habits (*)	- Case analysis - Incident analysis - Restarting simulation, simulation of emergency steps, disrupted situations

(*) prior to decision (instruction and signalling, communication and signalling...) on engines, on how to respond to disrupted situations (track with signal at danger, incidents) and in the restarting phase(s).

Teaching techniques include practice under supervision, table-top exercises on route-setting preliminary work, simulated break-downs, simulated engine-failures, use of trainsets for training purposes.

3.4. Change in the system not addressed

In this situation, the operator undertakes his/her own actions irrespective of the actual status of the overal system which is no longer perceived. The system is seen in its usual status and in a static way rather than in its actual status and in a dynamic way.



Change in the system not adressed

Actions are initiated while the cognitive competence and mental input are not suited to the status of the system. The usual acting-processes are not altered and the situation is controlled as it is usually. All links with the system have therefore disappeared but for the action undertaken which is supposed to produce its usual effect. In some instances, the skills and rules tend to be forgotten and gradually replaced by another form of SRK.

As in the previous case, **new training options can be considered, reflecting the overall cognitive structure.**

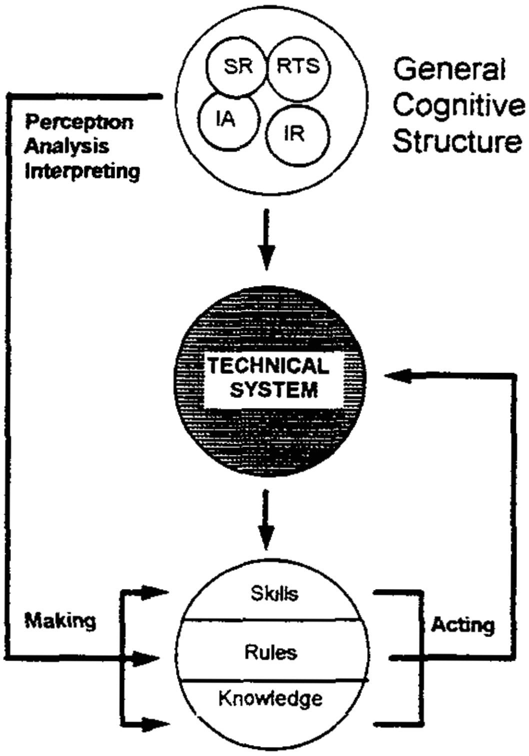
MAIN OBJECTIVES	RESOURCES TO BE USED
- Improve the signal/information detection reflexes - Improve awareness as to loss of alertness	- Information on alertness - Contributing factors - Training into improved alertness in the face of special circumstances (*) - Improved track visibility (sun, curves, trees...)

(*) normal situations (skills), uneasy situations (poor weather, complex environment), how to improve track visibility sun, trees, curvature...).

Teaching techniques could be geared to active training methods, suggested improvements (made by participants), checks on one's own-alertness (fatigue, stress, routine work, sun, trees, curvature...)

3.5 - Lack of communication

The cognitive input takes place but the exchange of information is not relevant in terms of contents and direction. The cognitive input is far from being adequate.



Lack of communication.

This scenario should be seen against the working environment of the operator. All the links may be in place but the right information is not reflected and namely the information whereby some system data should be addressed in order to change the overall cognitive structure.

As in the previous case, **new training options can be considered, reflecting the overall cognitive structure.**

MAIN OBJECTIVES	RESOURCES TO BE USED
- Enhance knowledge and compliance with communication procedures - Improve the synthesis capabilities and the consistency of communications means	- Training into radio communication procedures - Pratical training (simulator, case analysis/studies)

Teaching methods could be based on simulators and practical training for improvements to be obtained.

3.6 - Implicit rules

Everyone reckons to be acting according to non-written rules which are known to everybody. This rarely gives rise to oral messages since everyone's rules are taken to be obvious for everybody else.

Consequently, any colleague taking up the job on a more or less provisional basis is not informed about such rules, giving rise to potential accidents. The situation can be critical because work cannot be undertaken without such rules, which are in effect overall rules in the organisation subsequently adapted to the local circumstances and environment. They enable the various teams to get organised and reduce the lapse of time required for liaising and negotiating. Implicit rules are still potentially dangerous because they are not fully known and sometimes in conflict with the formal safety-based requirements.

New training options can be considered, reflecting the overall cognitive structure.

MAIN OBJECTIVES	RESOURCES TO BE USED
- Fuller integration of the safety considerations in the decision/making processes (*) - Improve the relations with the line management when safety is at stake	- Information on the subject (**), - Train line managers to give instructions in line with safety principles « do this if safety rules enable you to do so »

(*) those who cause train delays on account of safety reasons should not feel guilty.

(**) focus on cases whereby priority was given to safety considerations rather than punctuality and in which the positive action undertaken by members of staff was recognised.

Teaching techniques should focus on communications, stress the positive experiences and train supervisors, station masters, marketing officers in safety practice and performance.

CONCLUSION

Failures in the reasoning process of operators during safety-critical events demonstrate that knowledge acquired through learning and experience is not always used. Circumstances, cognitive structures and mental input levels were thoroughly analysed in order to highlight the varying nature of possible failures.

In this context, training can be designed *to bear on competence* in order to achieve a change in behavioural patterns on the workplace, i e. a change in the use of knowledge, know-how, attitudes or SRK as a problem-solving strategy in a given professional environment. Training is targetted at the end-effect, i.e governing the action on the system.

Any training exercise can be brought to bear on knowledge, know-how, attitudes, SRK and cognitive competence *simultaneously*, if necessary. Therefore training should be focused not solely on the acquisition of behavioural patterns but, more importantly, ***on the new forms of mobilizing such a competence***. But if the training action is aimed at one level only, there is a risk of producing robots who just cannot manage situations which have not been analysed during training or who have understood the right approach but cannot implement it

Analogy is often used in teaching techniques with a review of all possible situations against a given scenario but a better option is to expand upon the *rules* so that trainees may *clarify* them, *interpret* them and *act* accordingly. Understandingly the rules are only understandable and meaningful if supported by facts, i e. actual behaviours in the face of real circumstances.

This is why training cannot be restricted to sessions involving either simulated exercises on various situations or detailed explanations but it should be based on both, in a structured way, with a well-balanced combination of theory and practice, theoretical and practical approach. Training should strengthen the questioning and interactive approach of the operator so that he is trained to consider the situation and helped to better understand the situational aspects. Traditional teaching methods tend to give THE solution to a single problem, starting from the description of the situation : if you are in such a situation, you should do this... However few exercises are devoted to the identification of a situation or problem and the linkage between significant signs; there is a potential for procedures to be misapplied or short cuts to be found, thus ignoring the particular circumstances.

One should remember that training will not solve all problems. When devising teaching courses, the following should be borne in mind : if operators are fully prepared and briefed to respond to incidents, conservely it should be stated that **they may not come up with the right response** when faced with a normal situation. Understandably, this type of training should be accompanied by a review of the organisational arrangements and work contents.

The details set out in this paper are deliberately focused on training issues. Other findings relate to the organisation, management, communication, staff-selection issues... All aspects should be dealt with in order to progress consistently in the field of human reliability : this requires the organisational, cultural and social features of each company to be fully integrated.

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William N. Choi

Humanising Safety Management through user-friendly Operations Procedure Documentation Systems in MTRC

Publisher
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II/7 William N.F. Choi

Humanising Safety Management trough user-friendly Operations Procedure Documentation Systems in MTRC

Humanising Safety Management through user-friendly Operations Procedure Documentation Systems in MTRC

Overview

Introduction

On behalf of the Hong Kong Mass Transit Railway Corporation (MTRC), this paper is prepared for presentation in the International Railway Safety Seminar held in Mainz on 9-11 October 1995. It has been prepared by Mr. William N.F. Choi, who was appointed Operating Documentation Systems Manager on 1 October 1994 with the responsibility for:

- management of the Operations Documentation Redevelopment Project, &
- ensuring quality control and documentation systems are in place for the ongoing production and maintenance of Operations Divisional and Operating Departmental procedural manuals.

Purpose

The purpose of this paper is three-fold. It gives:

- a description of the MTRC and the Operations Division documentation requirements,

- a description of how it is possible to remove those "soft barriers" to successful safety management by improving the quality and the type of information available to staff, and

- an account of the recent Operations Documentation Redevelopment Project.

In this paper

This paper is written using the Information Mapping® writing methodology, and it contains the following topics:

Background

Brief MTRC history

The Mass Transit Railway was opened in 1979, and the system consists of three lines with a track length of 43.2 kilometres spread over 38 stations. It carries 2.3 million passenger trips each weekday.

The new Airport Railway, currently scheduled to open for passenger service by June 1998, will be another challenge for the Corporation in the coming years.

Strategy for the Operating railway

In running one of the busiest transport systems in the world, MTRC is committed to providing a safe, reliable and efficient railway service to the people of Hong Kong. The Corporation firmly believes that further progress can be made by the adoption of a more formal and structured approach to managing Quality and Safety.

Operations Division structure

The MTRC Operations Division comprises three departments:

- Operating Department (OPD), headed by the Deputy Operations Director, is responsible for the day-to-day operations of the railway,

- Operations Engineering Department (OED), led by the Chief Engineer(O), is responsible for the design and maintenance of railway equipment, and

- Safety Services Department (SSD), under the leadership of the Safety Services Manager, is responsible for managing railway safety in a systematic and proactive manner.

Operations Division documentation

Currently, there are over 30 Operations Divisional and Operating Departmental procedural manuals being relied upon by a total workforce of over 4000 Operating and Operations Engineering staff. They use these manuals as their main source of reference to meet with the safety requirements of their jobs. These 30 or so manuals are divided into 4 types:

- Operations Division Safety Manual,
- Operations Division procedure documentation,
- Operating Department procedure manuals and instructions, and
- Operations Engineering Department Quality manual, procedures and instructions.

Continued on next page

Operations Division Safety Manual

Currently, the Corporation's philosophy and strategy in safety management, safety requirements and a hierarchy of safety management standards are documented in the Operations Division Safety Manual.

The manual also covers a framework for a divisional implementation of the strategy set out in the MTRC Safety Policy through a Safety Management System integrated with various measures, safety management processes and areas of responsibility that ensure the policy is adhered to. The owner of Safety Manual is the Safety Services Manager.

Operations Division procedure documentation

There are a number of Operations Division procedure and instruction documents. The Rules and Procedures Manual, which sets out operational requirements on safety, is the Division's key safety standard for all day-to-day operational activities. This manual is supplemented by other divisional procedures which provide Operations staff with the information required to ensure safe and efficient performance of their duties. The owner of this manual is the Traffic Operations Manager.

There is a Qualification & Examination System in place to ensure that all qualified Operations staff are regularly tested on their knowledge and understanding of the information in the Rules and Procedures Manual.

OPD procedure manuals and instructions

To supplement the divisional documentation, there are other Operating Departmental procedures, reference manuals and instructions which provide Operating staff with the required information and guidelines to ensure safe and efficient operation of the railway. These provide the information required by operators in the day to day performance of their duties.
The Manual Owners are the respective Section Heads or Line Managers.

OED Quality Manual, procedures and instructions

The OED Quality Manual, owned by the Quality Services Manager, describes the OED policy, strategy, organisation, responsibilities and the Quality Management System, which is operated to implement the strategy set out in the quality policy. OED's Departmental Procedures referenced from this manual set out the working practices to be followed by all OED staff to ensure conformance to specified quality and safety requirements. They are supplemented by Work Instructions which detail the required activities and actions required.

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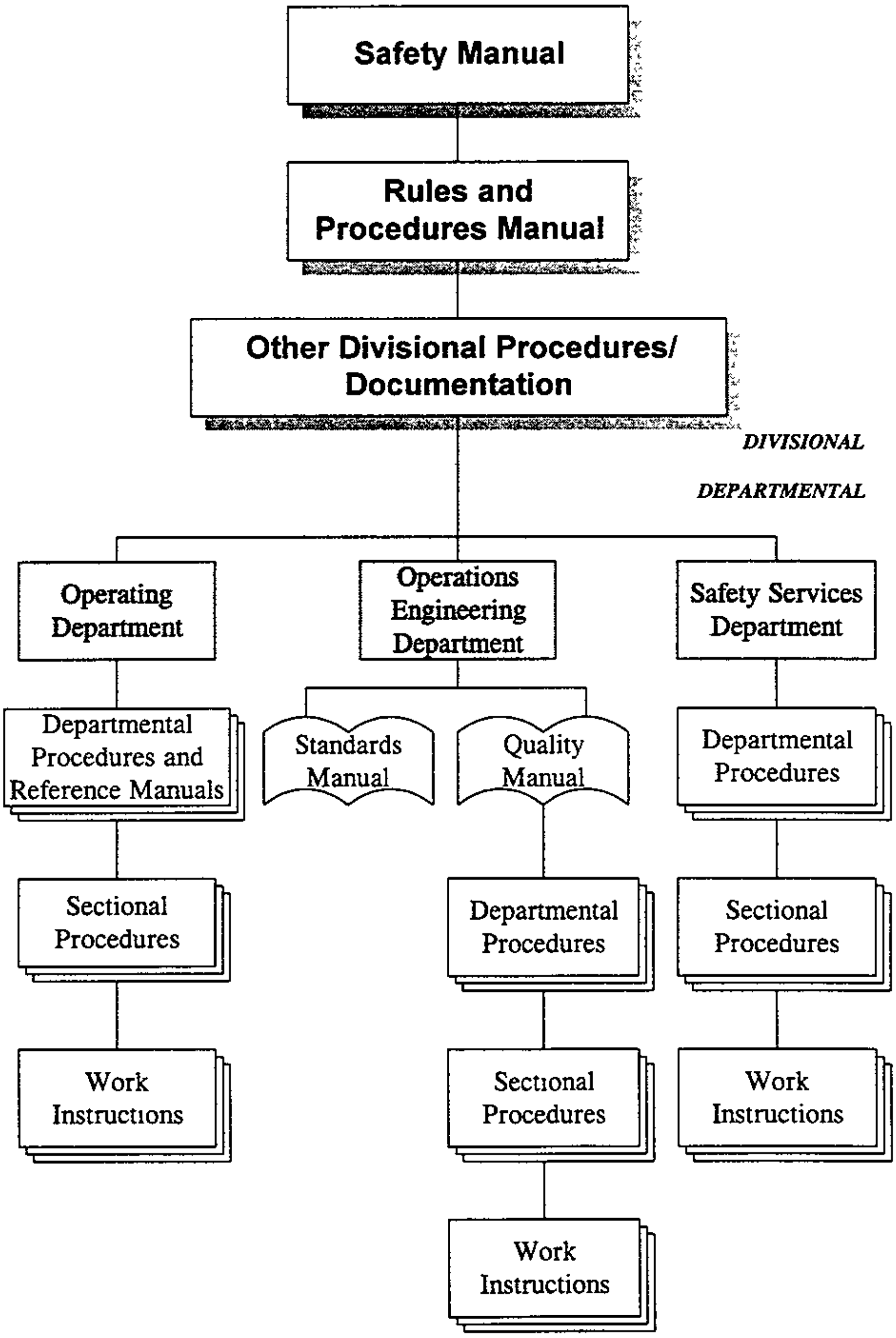
Documentation Hierarchy

The relationship between the various Operations Division documents can be shown in the form of a hierarchy. The Safety Manual, because of its policy information, sits above the family of Operations Divisional and other Departmental procedural manuals.



Emerging Concerns

The "Hidden" Report

Towards the end of the 1980's, the importance of providing clearly documented and up-to-date instruction for all railway activities was prominently expressed in incident reports such as the "Hidden" report, produced after probing into the causes of the tragic collision at Clapham Junction, which resulted in the death of 35 people.

The Hidden Report recommended that:

- " *Rule Book should be clear, unambiguous and helpfully presented.* "
- " *Rule Book and Book of Instruction of a similar status shall be promptly updated and observations made in this report taken into account.* "

Good Documentation enhances safety

Manuals themselves do not achieve safety; it is the people who achieve safety through them. Operations Procedure Documentation offers every Operations staff member the basis of systems and methods that will help in the achievement of safety performance standards. We need a good Operations Procedure Documentation System so that "we can do what is documented", and thereby reduce the reliance on supervisory staff to maintain a good safety performance. Furthermore, if the manuals are self-explanatory and able to stand alone, managers will need less time for answering questions, resulting in an increase of productive time that can be used to enhance safety in other aspects.

If we want to implement safety management successfully, we must first make the management system visible. To make a safety system visible, we must standardize and document it. To effectively communicate the safety management processes and requirements to the target audience, we must rely on a set of user-friendly documentation that is widely accepted and used. Once the documents have become reliable workmates to the staff, they help to reduce worker error and increase system use.

Research data has repeatedly shown that people who clearly understand their job tasks and have access to good manuals, work better and are more positive about their jobs with fewer chances for operational errors, and so achieve better safety performance.

Continued on next page

Good documentation supports quality

Modern documentation practice, reinforced by such ideas as ISO 9000, requires that instruction are issued in a clear, readable fashion on a need-to-know basis, with well-structured systems for documentation management and maintenance.

Within the Operations Division, there are documentation systems being set up, maintained and managed by the Safety Services Department and the Quality Services section of OED, which are in full compliance with ISO 9000 quality standards.

The adoption of a documentation methodology for Operations Procedures that is proven in the ISO 9000 arena is of primary importance if MTRC decides to seek Operating Department ISO certification.

Human factors

I once read a few remarkable quotes extracted from a journal called "Technical Communications", which describes the state-of-the-art documentation as getting into the heart of readers and caring for their needs.

> "*To the degree that we satisfy the basic human needs of our readers, we communicate successfully. To the degree that our writing fails to satisfy those needs, we fail to communicate.*" - Gerald Cohen

> "*The heart has such an influence over the understanding that it is worth while to engage it in our interest.*" - Lord Chesterfield

With the objective of reducing users' frustration in reading rules and procedures, and thereby increasing their understanding and confidence in taking the appropriate and required actions sensibly to enhance safety, there were a number of important human factors that needed to be addressed when developing the design of the new Operations Procedure Manuals.

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Motivation

Common reader problems are resolved by a consistent and better approach to analysis, organization, writing and presentation of information in the manuals that eliminate gaps and overlaps. Target users are motivated to take the correct action if they are given:

- well written, organised and complete information,
- scanning facilities to find the required information quickly,
- clear priorities and required actions,
- good examples and illustrations, and
- easy-to-follow and accurate information.

Sense of belonging

People tend to treasure things that clearly belong to them. Hence, manuals which have a job-based design, rather than being equipment or system based are more welcomed by operators as they are quicker and easier to use. In redeveloping the existing manuals, we tried to build well-structured homes for our Operations procedures. Users can therefore easily find what is relevant to the tasks they perform and are not forced to guess what part of the manual is useful to their jobs. This will lead to an increased use of the documents by users.

Understanding the "big picture"

Users need to feel confident that what they expect to happen will happen, and know what to do when things do not go as they expected. They must never be allowed to find themselves in the position of being totally lost and not knowing what to do. Even when the manual design is focused on the tasks to be accomplished, users need to understand the "big picture" before they can understand the specific steps needed to complete the task.

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Respect for the individual

Writers need to put themselves in the readers' shoes and produce documents that are sensitive to their human needs. We hold Focus Groups and interviews with manual users to find out what they want, and show our respect by responding to their needs since we want them to use our manuals willingly:

- **Easy-to-understand Information**
  Users must understand what they are reading. Readers tend to understand better through a consistent and easy-to-read writing style, supported with graphic/diagrams and presented in the language they are best at. It is really interesting to note that research indicated that most MTRC operators prefer to use the English manuals.

- **No Redundant Information**
  Reference information that does not directly support completion of a task will be separated from rules and procedures and made available as General/Equipment reference manuals. Also, information is given only to those who need it and therefore there is a reduction in the total amount of information distributed to users.

- **Easy Access**
  Users need to be able to access required information quickly. The purpose and intended audience are clearly defined at the beginning of each manual. The manuals are structured and designed based on the jobs people do, and any required information is easily identified and located. After completion of the rewriting exercise, online information systems with hypertext links will be developed to help users jump quickly to the latest relevant information.

- **Easy Maintenance**
  Users always welcome a simple and easy-to-follow manual amendment process that does not require them to spend too much time and effort in getting the most up-to-date and accurate information.

Emerging Concerns, Continued

Assurance of quality

The new Operation Procedure manuals are produced to ISO 9000 standards. To meet the required standards, appropriate Quality Assurance and Documentation Control Systems are in place. Quality is assured by documenting the work flow, issuing written procedures as to the methods to be used, and working in accordance with these standards. It helps to solve the problems of inadequacies in the current information and meet the requirements of safety and quality from the customer's perspective - "doing right the first time ".

Time commitment

We understand that accurate documentation of "what they do" is intellectually challenging and demands a high time commitment by Work Group Managers and Implementation Engineers.

In redesigning the Operating documentation process, we aimed to relieve some of the documentation workload currently undertaken by the implementing groups and thereby allow more project management time for the groups to address other safety concerns. To this end, we identified one owner and a number of Subject Matter Experts (SMEs) for each Operations Procedure Manual, and provided professional writers to do the drafting work based on the information supplied by SMEs.

Operating Department Documentation

Background

Since the opening of the Railway in 1979, the writing and publication of Operations procedures have been the responsibility of the Technical Information Unit of the Operation Planning section. In October 1994, this responsibility was taken over by the newly established Operating Documentation section.

Problems with the old manuals

Most of the old Operations Procedure Manuals had a system or equipment based design which was developed in the late 70's. Much of the language used in the manuals was very formal and the words used were very complex. Over the years, MTRC has incorporated new information into the manuals to cope with the changes in the railway. However, the additional information was homed on a rather ad hoc basis with reference information intermingled with procedures. As a result, the uncontrolled structure, inappropriate use of language and inconsistent format of the manuals made reading and assimilation difficult, especially for a reader whose first language is not English.

Furthermore, the situation has recently been compounded by mid-life system upgrade and equipment modifications, different equipment on different lines, and launch of new quality and safety initiatives which require higher standards of documentation.

The solution: a complete overhaul

Having realised that the MTRC Operations Procedures documentation did not reach the required standards to be seen as part of our total approach to Quality and Safety Management, MTRC wanted to enhance these manuals. We aimed to improve safety performance by putting more emphasis on proactive and user-friendly systems to ensure everyone's involvement in the management process.

The way that we are doing this is by undertaking a complete overhaul of the manuals, turning them into a series of customer-focused Operations procedures documentation, more suitable and easier for people to use. This approach has been supported by parallel studies in the Corporation carried out into human factor issues, both in the workplace and an in-depth course on the general principles of Human Factors, and operate from the premise that access to accurate and user-friendly information has a measurable effect on desired safety performance in the workplace.

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Expertise and resources

In early 1994, MTRC commissioned an Australian documentation consultancy company to conduct an evaluation of the existing suite of Operations Procedures Manuals, together with an analysis of the target audience. The aim was to ensure that all the new Operations procedures were documented in a style that could be understood without difficulty by all grades of staff required to comprehend and work from them.

To facilitate the redevelopment work, a team of 13 staff was deployed to form the new Operating Documentation section in October 1994. This team is responsible for the analysis, information design, redevelopment, management and maintenance of Operations Divisional and Operating Departmental manuals and related publications.

Subsequently, in December 1994, a consultancy contract was awarded to the same documentation consultant to work jointly with the MTRC documentation team to re-write the first 8 Operations Division procedure manuals, with a total size over 4,000 pages. Up to the end of August 1995, we had managed to complete 3 and the other 5 are very close to being ready for publication and distribution.

The Development Methodology

Quality Assurance Manual

To produce good quality manuals efficiently, we have developed a comprehensive Quality Assurance Manual, which forms the basis of development methods and systems. It also precisely spells out the various roles and duties of those involved in the processes. Adherence to these systems becomes a proven methodology for producing the most effective and user-friendly documentation, which meets our customer needs. This Quality Assurance manual covers:

- the Document Control strategy,
- the documentation development and checking processes,
- the documentation maintenance system,
- the documentation management system,
- the standards for document production, and
- a formal system for periodic reviews of documentation.

Standard writing methodology

Introducing Information Mapping® - a performance based documentation methodology which is a proven, systematic approach to the analysis, organisation and presentation of information in a consistent style. MTRC Manual Compilers and Manual Owners were fully trained in the use of the Information Mapping® methodology. A special template has also been developed to facilitate writers to format their WordPerfect documents in the Information Mapping® style.

Documentation standards

To ensure well-written and easy-to-follow documents with consistent structuring and presentation of information, a Standards Document was produced to be used by all personnel involved in the production process. This document sets standards for such areas as:

- acronyms,
- appearance of text,
- appendix,
- bullets,
- cross references,
- headers and footers,
- overview maps,
- page numbering,
- system related standards, and
- tables etc.

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Job-based approach

Before redesigning the new manuals, a task analysis of the manual users was conducted to determine what information is required, taking the following into consideration:

- what tasks are performed,
- who performs each task,
- when each task is performed,
- where each task is performed, and
- why each task is performed.

Manual ownership

A Manual Ownership System has been established in the new Operations Procedure Documentation System so that every Operations procedural manual has one unique owner. The Manual Owner usually enlists the help of the Subject Matter Experts (SMEs) to act as input resources and as document content reviewers. This helps to reduce the work load of individual line managers and avoids them perceiving the work required to produce good documents as a disincentive to working towards achieving high level of quality and safety.

Manual Ownership responsibilities are clearly defined and documented. They are required to maintain ultimate responsibility during the documentation process by:

- agreeing the content of manuals,
- deciding who needs the manual and approving the distribution list,
- developing and agreeing MTRC Operating information,
- ensuring the accuracy and completeness of information in their manual, and
- identifying new/changed information that needs to be incorporated into manuals.

Graphics/ diagrams

Where appropriate, graphics, diagrams and flowcharts will be incorporated to support the written text. This helps increase understanding by the users through visual presentation.

Online documentation

Conversion of the paper manuals to online documentation with hypertext links to ensure information is easily accessible and always up-to-date will be the next step, once the paper-based documentation is complete.

Conclusion

Achieving proactive Safety Management

By satisfying the basic human needs of our readers, the re-development of the Operations Procedure documentation enhances staff and organisational performance by implementing effective quality assurance and documentation management systems. It also turns ineffective documentation into user-focused and easy-to-use manuals with a number of visible benefits to:

- increase usage of the documents by users,
- increase users' confidence in following procedures due to well written and structured information,
- decrease the number of operational errors made due to operators having a better understanding of their job tasks and easier access to good information, and
- enable easy maintenance and updating of the documents so that users are always operating with the most up-to-date and accurate information.

All are essential contributory factors leading to a belief that safety in MTRC is being systematically and proactively managed.

Initial feedback

In July this year, after the publication and distribution of the first redeveloped Operations manual to some 2,000 staff, a survey was conducted to collect users' comments. From the 100 opinion sheets returned, it was obvious that the feedback from end users was overwhelmingly positive. Opinions expressed are summarized in the table below.

Attributes	Excellent / Good	Satisfactory	Improvement needed / Poor
Text Presentation	62%	35%	3%
Manual Structure	73%	26%	1%
Page Design	66%	30%	4%
Finding Information	62%	35%	3%
Overall Evaluation	**66%**	**31%**	**3%**

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Way ahead

To show its commitment to quality, MTRC is developing a coherent ISO 9000-based documentation system within the Operations Division. In Quality, we build a firm base for enhancing safety requirements.

With the recent agreement reached for the opening of the Lantau and Airport Railway (LAR) by June 1998, it is important that all inherent features of the re-developed manuals are being transferred to the LAR documentation to maintain consistency in both the design and standards.

Commentary

I firmly believe that good documentation imparts knowledge; and knowledge produces understanding, which is the key to any successful Safety Management. Ineffective documentation does result in frequent on-the-job errors and time-consuming reliance on extra resources.

Hence, it is logical to say that the effectiveness of the Documentation System in communicating the required standards to a workforce of an organisation is a measure of the health of its Safety Management System.

Finally, I sincerely hope that after the existing suite of Operations Procedure manuals have been rewritten to meet the highest standard of quality and reader-friendliness, I am able to turn around the concept that reading the Rules and Procedures manual is a pain for MTRC staff.

Acknowledgements

I wish to thank MTRC for its assistance, especially Mr. Roger Kynaston, my governor who gave me this opportunity to share my experience with you in this seminar. I would also like to thank Mr. George Lee, MTRC Safety Services Manager and Miss Christine Seabrook of TACTICS Consultancy, who both gave me some very useful advice and support.

DoSM/paper1.6/August 1995

International Rail Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9513

Kaoru Takahashi

Safety Measures for Track Workers

Publisher
2000 International Rail Safety Conference

III/1 **Kaoru Takahashi**

Safety Measures for Track Workers

INTERNATIONAL RAILWAY SAFETY SEMINAR

Mainz

October 9. - October 11. 1995

Safety Measures for Track Workers

Kaoru Takahashi

Vice Director of the Safety Research Laboratory
East Japan Railway Company

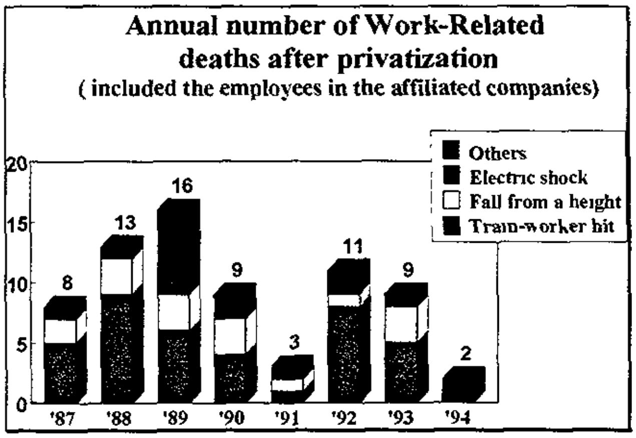
1. Introduction

Despite gradual decrease in derailments and collisions involving East Japan Railway train operations, the number of work-related accidents has not declined significantly. Trains hitting workers make up about 50 percent of the accidents resulting in death, and more stringent preventive measures should be taken immediately. Such measures are introduced here along with the relevant preventive devices, their functions and development.

2. Current status of work-related accidents

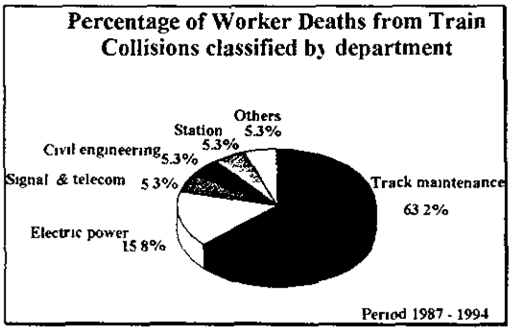
(1) Number of accidents resulting in death

Since the inauguration of JR East, the number of accidents resulting in death has fluctuated but the trend has not decreasing one. Accidents in which workers are hit by trains account for about 50 percent of all fatalities. Accordingly, urgent measures to prevent such accidents are necessary.



(2) Cause of train-worker hits

Track maintenance workers are involved in about 60 percent of the train-worker collisions, preventive measures are urgent for wayside work, especially track maintenance work.



Percentage of Worker Deaths from Train Collisions classified by department

Period 1987 - 1994

(3) Link between track maintenance work and train-worker hits

As most track maintenance work is carried out during the intervals between train runs, and not when a line is closed down, accidents involving trains and workers occur when worker fails to notice a train entering the work-in-progress section and consequently does not take the necessary safety measures in time. Double-track section, where train frequency is high and there is one way traffic per line, are considered to be the reason why there is often insufficient work time between trains. The double track lines in Japan are different from that of European railways where trains on double-track lines generally run in the same direction. A worker often makes mistakes while dividing his time watching for trains.

As the start and end of work on closed track sections is decided in the field, misjudgment may lead to workers being hit by a train. If a worker makes a mistake on the time of a passing train immediately before work on the closed track section begins, a train may enter while work is in progress.

Accidents involving a worker and a train operating on neighboring track of double or quadruple lines have also occurred.

From the standpoint of actual working conditions, effective preventive measures can be taken if approaching trains are detected systematically and precisely.

3. Safety improvement measures

Basic improvements include 1) starting work only after closing down a line, 2) possible closure of double lines and 3) the prevention of oncoming trains from entering a closed section via signals operated by on-site workers. However, as these measures can not be implemented immediately, devices to detect approaching trains has been introduced and the training of key field

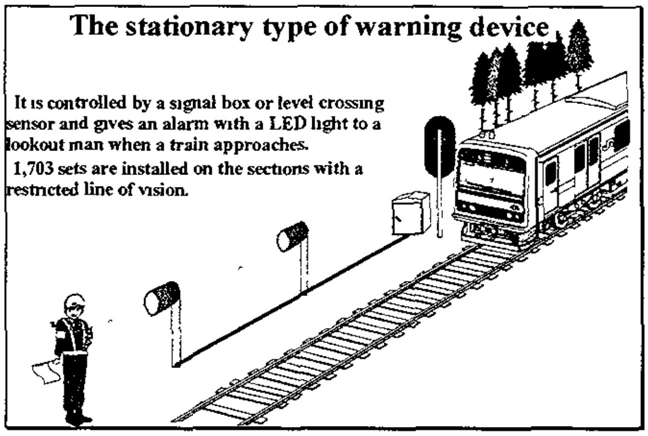
workers to upgrade safety practices has been carried out in order to reduce accidents caused by human error.
Here, the devices will be introduced.

4. Current warning devices for track workers

At present two types of devices are in use.

(1) Stationary type

This device is installed in advance at tunnels, curves, bridges and other places where sight is highly restricted. Field workers are notified of approaching trains by a LED light, which utilizes track-circuits that provide information to signals.

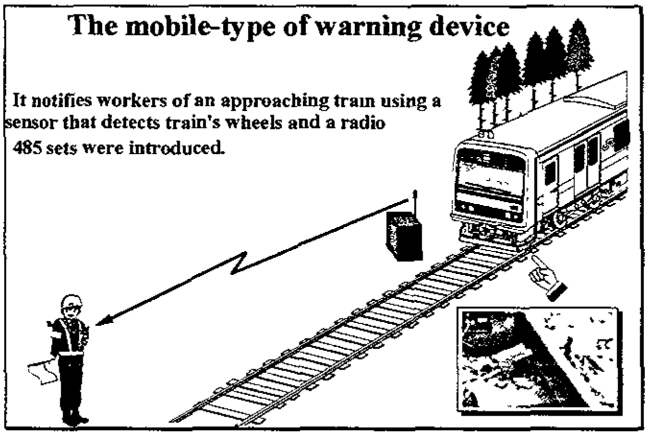


The stationary type of warning device

It is controlled by a signal box or level crossing sensor and gives an alarm with a LED light to a lookout man when a train approaches.
1,703 sets are installed on the sections with a restricted line of vision.

(2) Mobile type

This type of device is brought to and installed at places where work is under way.
A sensor, which detects wheel movement, is placed on the ground. Information of an approaching train is then transmitted via radio to notify workers of the coming train.



The mobile-type of warning device

It notifies workers of an approaching train using a sensor that detects train's wheels and a radio
485 sets were introduced.

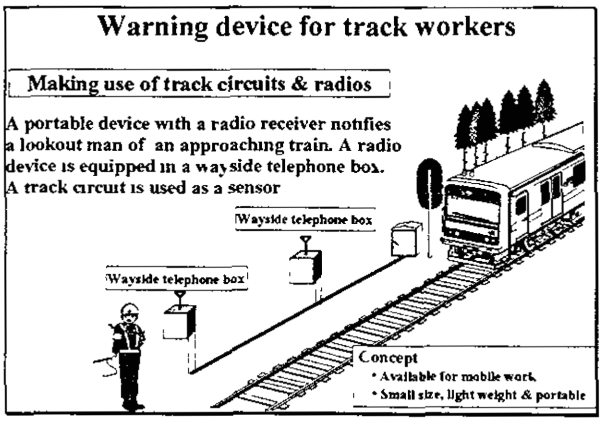
Both types have the following advantages:
- Fail-safe features.
- Can be used for extended periods (especially the stationary type)

On the other hand, there are the following disadvantages:
- Inappropriate for mobile work.
- Mistakes or problems can occur when installing the sensors the devices and when turning on and off their power.

5. Devices under development

Placing emphasis on small size and lightweight, JR East plans to develop devices that can be used for mobile work.

The detection of train location and the transmission of information are the key points and two types of devices are under study.



One type of device carries out detection using the detection using the by track circuit and employs radio and telephone circuits along railway lines to transmit information. This device requires equipment adjacent to the track. The other type of device employs GPS satellites to detect train location and sends information by radio. This device requires equipment aboard a train but not along the track.

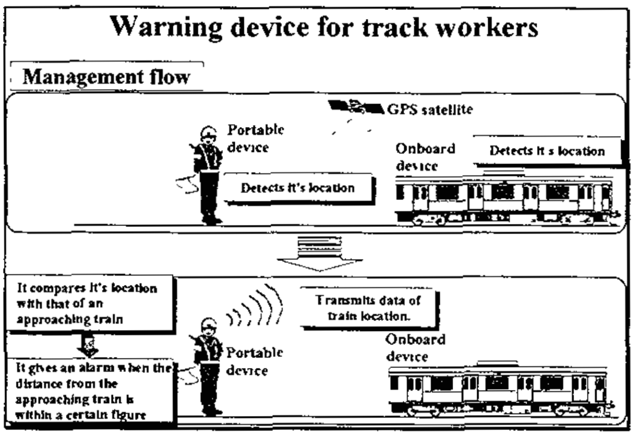
Tests to confirm the basic functions of both of these devices have been carried out and improvements have been made for their practical use.

The explanation about the second type of device (utilizing GPS satellites) is given here.

6. Outline of device utilizing GPS satellites

(1) Management flow

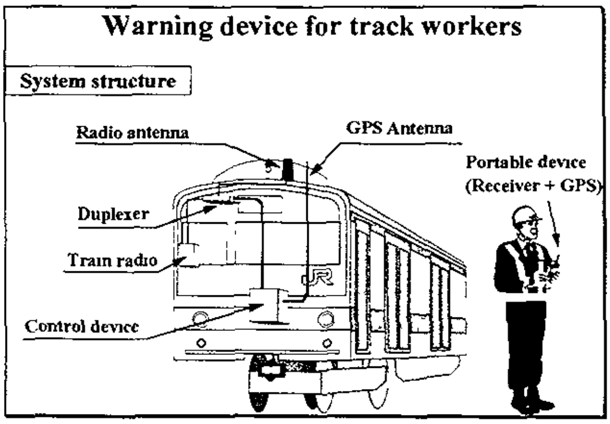
The exact locations of trains and workers (who are working on the tracks and need to be warned of approaching trains) can be determined using GPS satellites. (At this time, operation requires only the turning on of their power.)



A train transmits data on its location by radio during operation. When a portable device receives this radio signal, it compares its own location with the train location. When the distance between the two approaches a certain figure (estimated at about 1.5-2.0 kilometers), an alarm is automatically given to notify workers of the approaching train.

(2) System formation

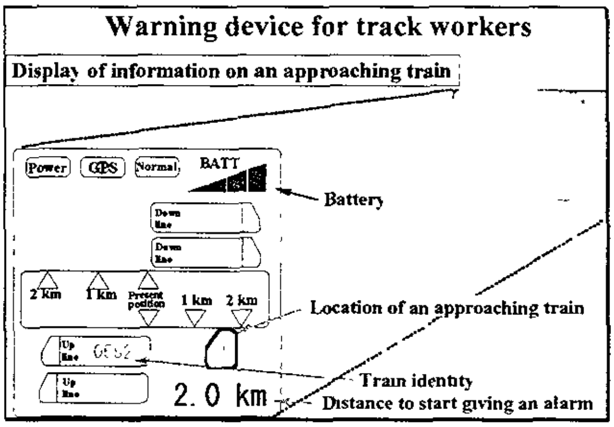
A control device outfitted with a GPS receiver and a radio are the main equipment aboard rolling stock, while the portable device with GPS- and a radio-receiver is small and lightweight, weighing about one kilogram including a battery.



(3) Main features

Developing a device easy to handle

- Small, light and portable. Can be used for mobile work.
- Unnecessary to install on-the ground equipment or to switch the equipment on and off.
- Simple operation. Just switch it on ---no other operation should be required.
- A small display screen will allow a worker to see the number of an approaching train and his own location.



A device equipped with the following characteristics are considered in order to realize the above.

- No wayside facilities will be required. The device will be an onboard self-supporting and direct signal-dispatching type.
- Radios should be used for information transmission.
- Wired communication will not be used.
- Independent equipment using GPS satellites will be used to determine location.
  (The precision of the warning device for track workers will be accurate to +/- 100m.)
- Preventive measures against breakdown and transmission errors will be taken for both on-board equipment and a portable device on wayside.

(4) Development status

Basic data were collected in 1993, and functional testing of an experimental device was performed in 1994 on a revenue line using actual trains. The results of location detection and data transmission, which are of the utmost importance, went almost according to plan.

7. Future scheme

Improvements in reliability centering on breakdown prevention and simplification of operations are carried out and a long-term investigation is planned in 1995.

As the on-ground devices that have been in use and the devices under development have different characteristics, they will be put into use on a line-by-line basis. For example, the existing method using wires and the system using track circuits are useful on lines where train frequency is high and in tunnels, while the devices mentioned above are advantageous for longer lines and where there is limited number of rolling stock.

In addition to the emphasis on functions and formulas, the development of devices that users really want and that are easier to handle is important. With this in mind, JR East is planning to promote this project in the future.

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Paper 9514

Hans Peter Hadorn

Safety Measures for Track Workers

Publisher
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III/2 Hans-Peter Hadorn

Safety Measures for Track workers

International Railway Safety Seminar 1995
09 - 11 October, Mainz / Germany

Paper presented by: Hans-Peter Hadorn, Safety Manager, Swiss Federal Railways, Berne

SAFETY MEASURES FOR TRACK WORKERS

1. Introduction

Brief presentation of the SBB's organisation:
- organisation chart
- workforce
- performances in passenger/km and freight ton/km 1994
- passenger traffic and freight traffic turnovers 1994

Basic principles:
The safety of own staff and staff of private contractors working in and near the tracks is a recurrent, important point on the SBB's agenda. The safety concept is contained in a regulations booklet, and is implemented by a permanent education and training of all concerned.

In spring 1994, 9 passengers of a fast train were killed in an accident, when this train was passing a construction site. This tragic event gave rise to a number of investigations, one of which being a special study called "Sicherheitsdispositiv Baustellen" (safety organisation at construction sites).

1.1 Objective of the presentation

The following presentation attempts to show which are the findings that could be gained from said study, and how they are put into action in the practical every day work.

Further, a brief glimpse is thrown on the project "improved work safety", which also covers important elements of construction site safety

2. The project "Safety Organisation at Construction Sites"

21 Project organisation and its course of action

The choice was given to an organisation based on a phasing of procedures.

Phase 1: Stocktaking and analysis of the present situation.

Phase 2: Translating the established improvement measures into a bundle of measures.

Phase 3: Translating the measures to actual practical work, coordination of the projects "safety at construction sites" and "improved work safety", and carrying over to the part project "foreman training".

211 Phase 1: Stocktaking of present situation and analysis

Working group, headed by a regional director, composed of specialists from the concerned departments of the general direction and of the regional managements

Stocktaking by way of hearings, including also companies outside the SBB.

Final report with 56 identified measures for improvement, broken up into:
- 13 measures "management and staff"
- 24 measures "organisation"
- 19 measures "technology".

Findings:

- Safety must be a direct concern of management and is a function of personal attitudes.

- Targeted and efficient education and training at different levels, coupled with a strengthened controlling, brings about a considerable reduction of risks.

- Weak points in the internal organisation and at external contractors (weak elements in the safety process).

212 Phase 2: Implementation

With the issuance of the final report, implementation was initiated. Based on this report, a bundle of measures was worked out which is being implemented by a new project organisation.

Steering committee as supervisory body for the overall project management (Civil Engineering department) and for the part projects relating to specialist fields.

The bundle of measures comprises 20 partial bundles which are being handled by specially defined project groups.

213 Phase 3: Translating the measures into practical work

The translation into practical work needs about internal and external costs of 1600 working days and 1.1 million SFr.

Practical experience shows that a close coordination with the concurrent major project "Improved work safety at the SBB" is a must, because considerable parts of the project "Safety measures for track workers" concern tasks from the field of work safety.

Apart from the technical training of the personnel on construction sites, it is also necessary that a new safety culture is introduced through professional education. This new basic attitude of all SBB staff towards safety is being induced as part of the project "Work safety". A special seminar, worked out by SBB specialists and external consultants, is offered to the top management. This seminar is very much practice related, and theoretical instruction is confined to an absolute minimum.

3. Recapitulation

The tragic accident of spring 1994 has drastically revealed that the safety on construction sites of the SBB is in need of improvement.

The analysis of the situation has clearly shown that technical measures alone, are not sufficient to guarantee safety at construction sites. Even more important are organisational, and in particular, management aspects. These are the the decisive criteria for a high standard of safety at construction sites.

The SBB have summed up these findings in a comprehensive bundle of measures to remedy the situation. These measures are currently being put into action, and the pertaining works will be terminated by end of 1995.

But the intensified professional education of all staff on all levels, will continue. Its objective is to establish a new safety culture, in which safety considerations are ranking as high as productivity and quality.

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Paper 9515

Michael Harwood

Improving Safety for Trackside Staff
An evaluation of the BR/Railtrack Project

Publisher
2000 International Rail Safety Conference

III/3 Michael Harwood

Improving Safety for trackside Staff - an Evaluation of the BR/Railtrack Project

SLIDE

1 IMPROVING SAFETY FOR TRACKSIDE STAFF

AN EVALUATION OF THE BR/RAILTRACK PROJECT

2 1. Introduction

1.1 This paper describes how and why personal track safety on the Railtrack network has improved since 1990. This network was the responsibility of British Rail until 1st April, 1994.

1.2 Relevant safety performance is described against the objectives set and the various "human factors" initiatives taken since 1990 are also described.

1.3 Finally, the paper points towards future work required to continue to improve levels of safety associated with trackside activities.

3 2. Definition

2.1 The term "track safety", in the context of this paper, means "the avoidance of trackside workers who maintain or repair the infrastructure being struck by trains or track maintenance machines whilst undertaking those activities".

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2.2 Obviously there are many other occupational hazards associated with track safety but these are allied to the particular engineering activity being undertaken, for example welding or lifting rails, or arise as a result of travelling by road to or from work sites. These are not the principal hazards addressed here since they are not necessarily unique to a trackside situation - being struck by a train certainly is!

4 3. Background

3.1 The track safety record on British Rail for the period 1984/85 to 1991/92 was regarded as far from satisfactory. It was however far better than it had been forty years previously when, for example, in 1948 no less than 125 track workers were killed on Britain's railways. Since that time the year on year absolute numbers of fatalities had gradually reduced, but approximately 8 per year in the late 1980's, a risk of 1 in 3700, was clearly too high.

5 3.2 It was an unfortunate series of track fatalities during 1990/91 which led BR to initiate a radical study of the issues involved.

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3.3 The study was undertaken during 1992 and a key objective was to identify the underlying or root causes of trackside accidents.

3.4 The report recognised that there were opportunities to reduce the risk of being struck by a train. The principal conclusion reached was that working arrangements should require far more physical separation of people from trains. The report acknowledged that total separation would be impracticable and not cost-effective but should be achieved in far more situations than was then the case.

6 3.5 The study led to a dedicated Track Safety Project with key objectives to:

- raise awareness of the latent hazards associated with working on the track, and
- develop revised procedures to increase occasions when track workers can be separated from trains.

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3.6 The study also led to a better focus on the development of quantification of the risks associated with track safety and to specific safety objectives being set to reduce those risks.

7 4. Initiatives

Since 1990 there have been several major initiatives aimed at improving track safety performance. These are:

- PERSONAL TRACK SAFETY TRAINING
- A PERSON IN CHARGE OF WORK (PICOW)
- BETTER COMMUNICATIONS
- REVISED RULES
- HIGH-LEVEL STANDARDS
- BETTER ACCIDENT INVESTIGATION TECHNIQUES

8 4.1 The introduction of Personal Track Safety training and certification for all personnel whose duties take them on or near the line. This involves a written examination on the conduct necessary to ensure personal safety. It applies equally to managers, drivers and anyone else whose duties require them to be exposed to danger on the track no matter how infrequently.

9 4.2. The introduction of the role of Person In Charge of Work (PICOW). This arrangement in effect established the principle that before a group of people can enter within the high risk area of on or near the line, a safe system of work must be established by the PICOW and he must ensure that the group under his control are fully briefed in that safe system before work commences.

10 4.3. Communication is an absolutely vital ingredient of any recipe designed to achieve cultural changes. The Track Safety Project has endeavoured to communicate continuously with the railway community. This has been even more vital over recent years with wholesale reorganisations taking place at the same time, not the least of which was the division of the BR structure in April 1994 when Railtrack was formed. Talking and listening to all concerned, and consulting on and testing new ideas have been essential, in addition to the use of management briefs, and articles in in-house magazines and videos. A dedicated track safety campaign has been entitled "Keep Safety First".

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11 4.4. A key development arising from the Track Safety Project has been the revision and enhancement of relevant Rules, again with the main aim being to separate track workers from trains, and protect them by fixed signals whenever practicable. The key elements of The Rule changes, implemented in April this year, are as follows:-

- clear guidance on the correct procedures and terminology to be used to make sure there are no misunderstandings when communicating messages concerning safety by telephone or radio,

- a new track safety colour coding system to assist the Person In Charge Of Work to determine the most appropriate system of protection for his group: All sites of work within 10 feet of any line or siding are to be regarded as either a RED or a GREEN ZONE.

12 - GREEN ZONES are preferred because they require train movements to be stopped.

13 Cont 4.4 - protection procedures additional to signals being maintained at danger to be implemented prior to commencing work but with the Signalman's permission are:-

- the use of a Track Circuit Operating Device, or
- the disconnection of a signal or signal route, or
- the appointment of one or more handsignalmen.

14 GREEN ZONES also need to be protected from the danger of trains passing on adjacent lines by either providing fences or a 'Site Warden' whose duty is to ensure that no worker moves nearer than 6 ft 6 inches to such lines.

RED ZONES are work sites on lines open to traffic and therefore should only be used where it is not possible to arrange a GREEN ZONE. Work is only permitted in a RED ZONE when Lookout protection is provided. This must ensure that warning is given to enable everyone to reach a position of safety at least 10 seconds before the arrival of a train.

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15 4.5 High level Standards have also been developed to support the more detailed Rules. These lay down the <u>competencies</u> required in connection with Personal Track Safety, PICOW, Lookout and Site Warden responsibilities previously referred to. This approach is consistent with our general approach to Standards by establishing the competencies to be achieved in connection with such responsibilities, leaving the employers of the people undertaking them to put in place effective selection and training arrangements to meet those competencies.

16 4.6 A technique has been developed jointly between Railtrack and Manchester University called RAIT (Rail Accident Investigation Technique). It has two aims:-

- first, to be used by accident investigators to identify the failed defences, unsafe acts, situation preconditions and underlying organisational factors implicated in an accident.

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Cont 4.6 - and secondly, by accumulating data from a number of incidents, RAIT can begin to characterise the important and recurring features of accidents on the Railway.

The system has been produced as a windows software program. The program once tested will be made available to accident investigators. The system guides the investigator through the investigation prompting questions to be asked which may otherwise have been overlooked. It initially classifies the accident into type, severity etc. and then develops lists of unsafe acts, technical breakdowns and system failures. These are then rated against organisational factors - planning communication, maintenance etc. - according to their contribution to the accident. This gives the root causes. Data can be sifted in various ways to produce long term trends and information of particular interest.

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17 5. Safety Objectives and Actual Performance

5.1 A quantified objective for track safety was set in 1993 following the completion of the study previously referred to. This was that new safe systems of work for trackside activities would be introduced to reduce the trackside worker fatality risk from all causes to one in 5,000 per year by the end of March, 1995.

5.2 This objective was achieved in 1993/94. Indeed, the period between July 1993 and December 1994 - 17 months - saw no fatalities to track workers caused by being struck by a train.

5.3 The target was more than achieved in 1994/95 when in fact the risk level was better than 1 fatality in 10,000. This has now become the target to be achieved consistently by 1998, and therefore we need to ensure that we can achieve or better such a level year in and year out.

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18 5.4 We subjected the Rule changes I have described to a Risk Assessment in order to quantify their safety benefit. This assessment concluded that the 1995 changes would lead to reductions to annual levels of 2-3 fatalities and this is consistent with the objectives I have already described.

5.5 To sustain these improved levels of risk over the forthcoming years the industry needs to build on the success of the track safety project and the resulting initiatives I have described - some of which have still to bear full fruit.

19 5.6 Trackside safety performance is well within the "As Low As Reasonably Practicable" region of the recognised risk profile supported by the British safety regulatory authority, the Health & Safety Executive.

20 6. <u>Where To From Here</u>

6.1 The objective for 1998 has already been described.

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6.2 We certainly cannot be complacent following the successful achievement of objectives over recent years. I earlier described how 17 months had elapsed without any fatal accidents occurring due to track workers being struck by trains. However, in the same period there were at least 100 reported serious near-miss incidents. We therefore need to ensure that all such incidents are reported to enable lessons to be learned. A no-blame culture which we encourage, will help in this respect.

6.3 The two fatal accidents to track workers in 1994/95 each involved people on their own. One of these was in fact a lookout for another group of workers who at the time of the accident had temporarily stood down from their work. We therefore need to ensure that track workers concentrate more on their personal safety when working or walking alone.

SLIDE

6.4 A further development which, potentially, could have an adverse effect on the improving trends described, is the use by Railtrack of contractors rather than directly employed personnel.

At present, the contracts for track or signalling maintenance or renewal are largely with the British Rail infrastructure units. However, Railtrack recognises that it needs to ensure that any organisations it may contract with to undertake such activities are able to ensure that fully competent personnel are provided. In order to achieve this, and other key safety arrangements, a “contractor’s safety case” is required to be presented and accepted by Railtrack before a contract is let.

The safety case will therefore be the means by which the contractor can demonstrate that he is able to ensure the safety of his own personnel when undertaking the contract. A demonstration of compliance with the Rules and Standards previously described will be an essential part of such a safety case.

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6.5 We need to continue the successful communication campaigns on trackside safety that have been the hallmark of recent years. It is only by reinforcing the essential messages concerning trackside safety that continuous improvement can be achieved.

6.6 The RAIT technique described previously, although still in its infancy, is enabling us to gain an insight into the causes of accidents which otherwise would be put down to human error. We are yet to realise RAIT's full potential, but we feel there are clear benefits to be obtained from deeper investigation of accidents and better data management.

21 7. Conclusions

7.1 From the excessive risks experienced in the late 1980s, BR and Railtrack have, principally through a focused project, been able to improve trackside safety performance to achieve a fatality rate of 1 in 10,000 per annum in 1994/95.

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7.2 However, Railtrack recognises that it cannot be complacent and needs to continue its efforts - involving effective communications and human factors initiatives, and **managing the interfaces with increasing numbers of contractors - to consolidate the safety improvements achieved and ensure that the Objective for March 1998 is met.**

MICHAEL HARWOOD

HEAD OF OPERATIONS UNIT

SAFETY & STANDARDS DIRECTORATE

RAILTRACK

OCTOBER, 1995

IMPROVING SAFETY FOR TRACKSIDE STAFF

An Evaluation of the BR/Railtrack Project

SYNOPSIS

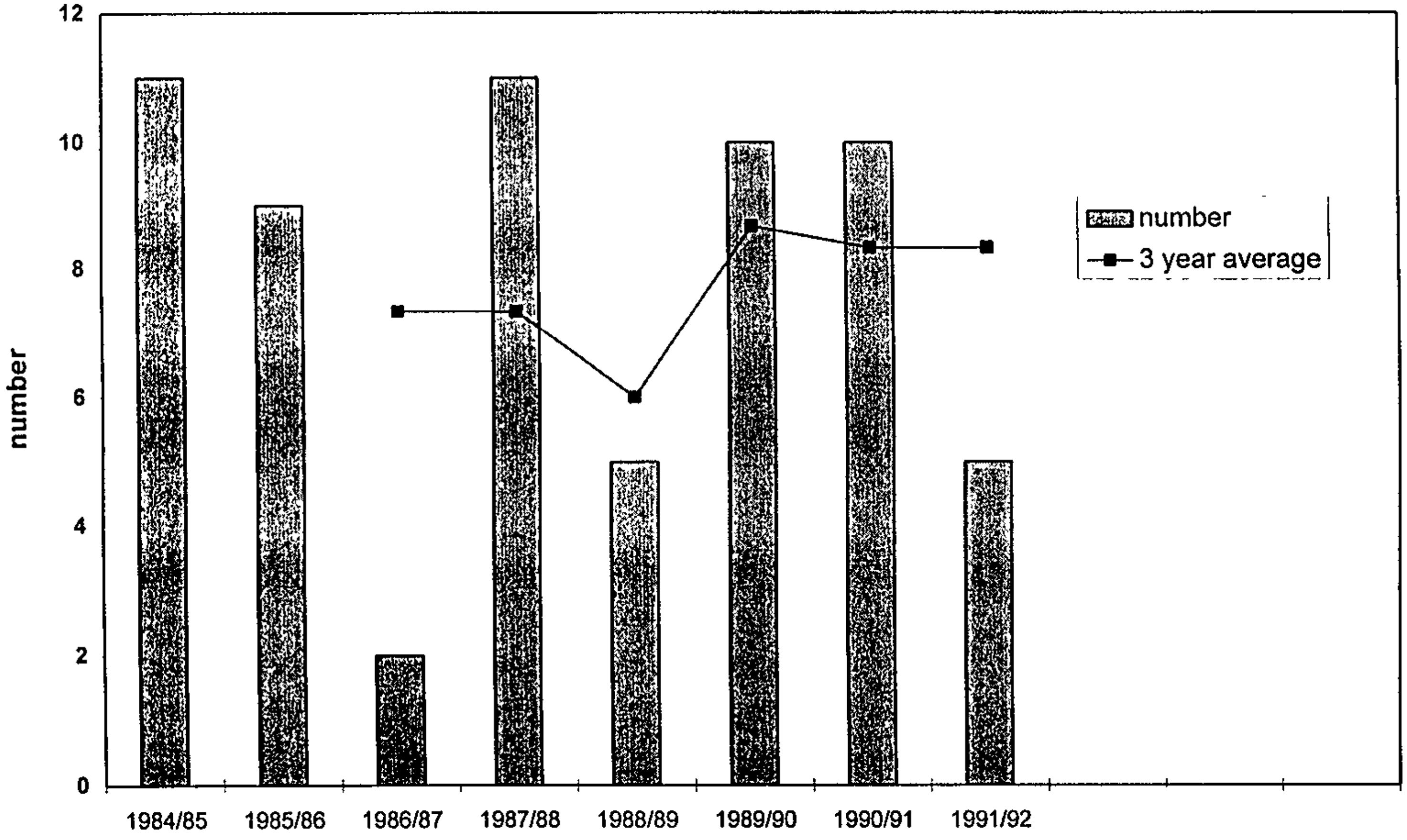
- PERSONAL TRACK SAFETY IMPROVED SINCE 1990
- SAFETY PERFORMANCE
- SAFETY OBJECTIVES
- INITIATIVES
- FUTURE WORK

TRACK SAFETY

" The avoidance of trackside workers who maintain or repair the infrastructure being struck by trains or track maintenance machines whilst undertaking those activities"

EXCLUDES other occupational hazards associated with the activity.

Trackside workers struck by train
(1984/5 - 1991/2)



June 1995

- RADICAL STUDY - 1992
- OPPORTUNITIES TO REDUCE RISK
- PHYSICAL SEPARATION OF PEOPLE FROM TRAINS

TRACK SAFETY PROJECT OBJECTIVES

- RAISE AWARENESS OF LATENT HAZARDS
- REVISE PROCEDURES TO INCREASE OCCASIONS WHEN TRACK WORKERS CAN BE SEPARATED FROM TRAINS

BETTER FOCUS ON QUANTIFICATION OF RISKS AND SPECIFIC OBJECTIVES

INITIATIVES

- PERSONAL TRACK SAFETY TRAINING
- A PERSON IN CHARGE OF WORK (PICOW)
- BETTER COMMUNICATIONS
- REVISED RULES
- HIGH-LEVEL STANDARDS
- BETTER ACCIDENT INVESTIGATION TECHNIQUES

PERSONAL TRACK SAFETY

- ◆ TRAINING AND CERTIFICATION
- ◆ APPLIES TO EVERYONE WHOSE DUTIES TAKE THEM ON OR NEAR THE LINE

PERSON IN CHARGE OF WORK (PICOW)

- ◆ A SAFE SYSTEM OF WORK MUST BE ESTABLISHED BY THE PICOW
- ◆ PRE-WORK BRIEFING

COMMUNICATIONS

- ◆ VITAL FOR ANY CULTURAL CHANGE
- ◆ REORGANISATIONS
- ◆ TALKING, LISTENING, CONSULTING
- ◆ "KEEP SAFETY FIRST"

REVISED RULES

AIMS

* SEPARATE TRACK WORKERS FROM TRAINS WHERE POSSIBLE
* PROTECT BY FIXED SIGNAL WHERE PRACTICABLE

ELEMENTS

* CLEAR UNAMBIGUOUS COMMUNICATION
* NEW TRACK SAFETY COLOR CODING SYSTEM

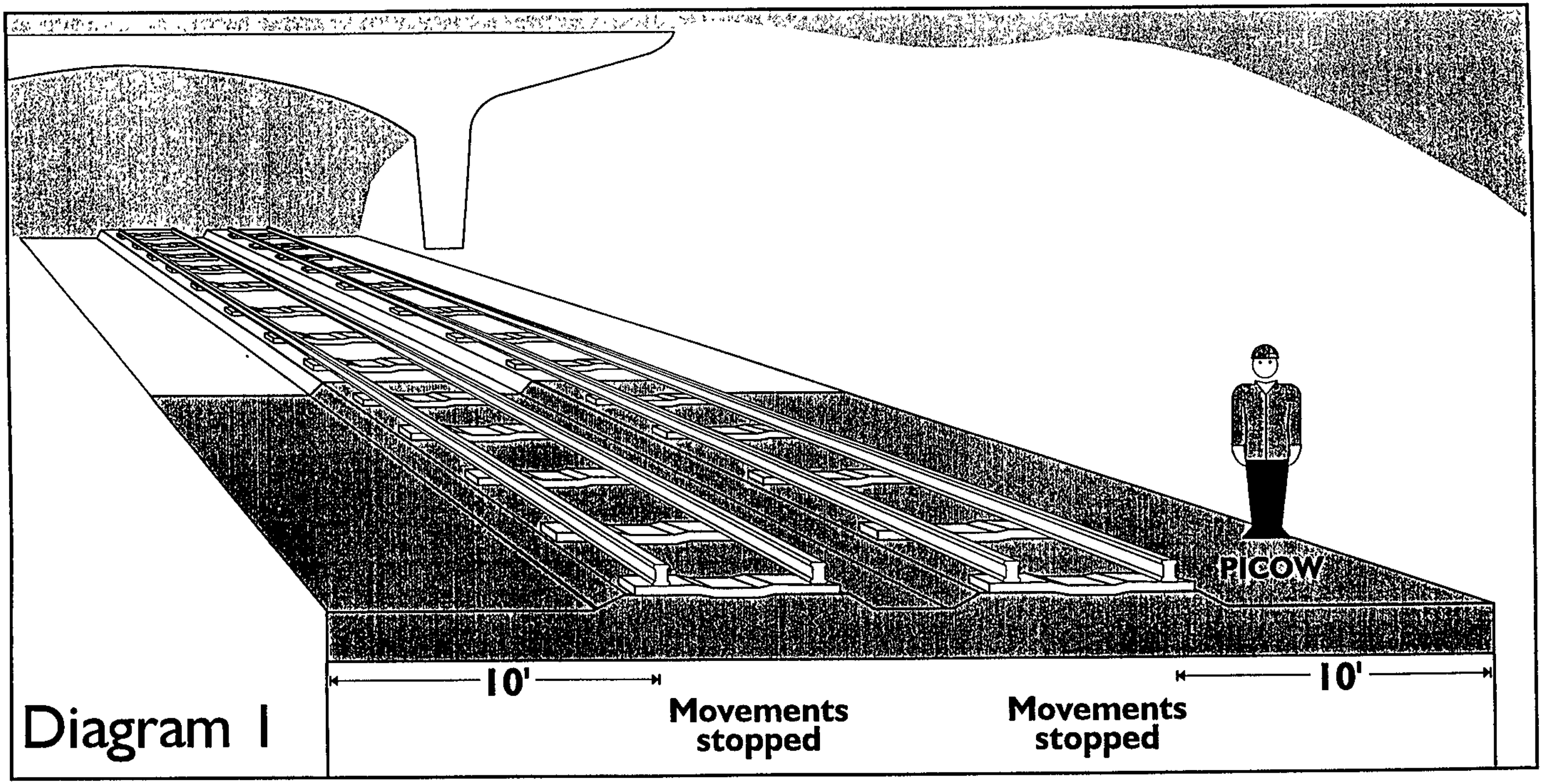


Diagram 1

ADDITIONAL PROTECTION PROCEDURES

- TRACK CIRCUIT OPERATING DEVICE (TCOD), OR
- SIGNAL DISCONNECTION, OR
- HANDSIGNALMAN

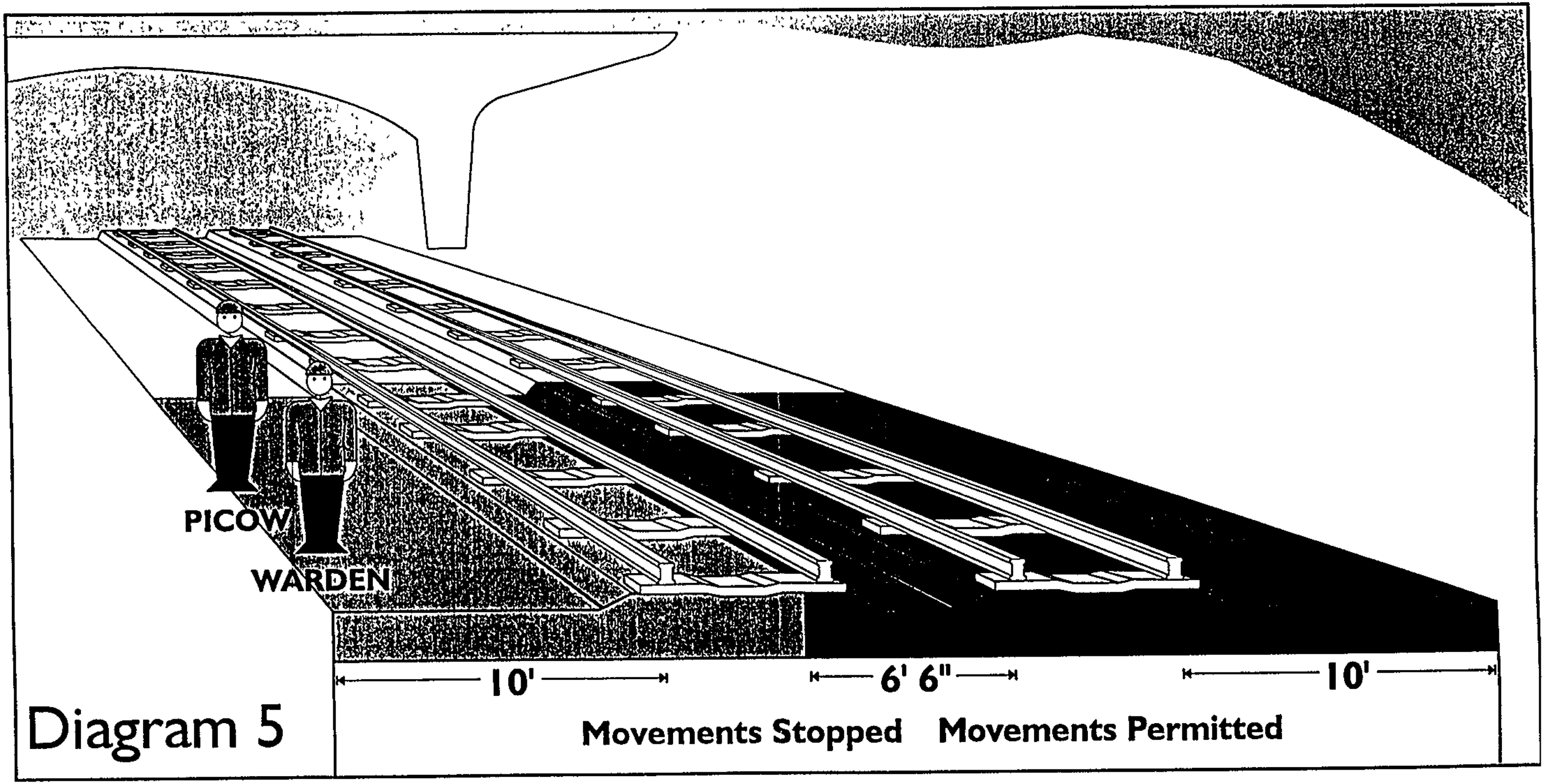


Diagram 5

PICOW
WARDEN
10'
6' 6"
10'
Movements Stopped
Movements Permitted

HIGH LEVEL STANDARDS

- COMPETENCIES
- EMPLOYERS TO DETERMINE SELECTION AND TRAINING ARRANGEMENTS

RAIL ACCIDENT INVESTIGATION TECHNIQUE (RAIT)

* TO IDENTIFY THE FAILED DEFENCES, UNSAFE ACTS, SITUATION PRECONDITIONS AND UNDERLYING ORGANISATIONAL FACTORS IMPLICATED IN AN ACCIDENT

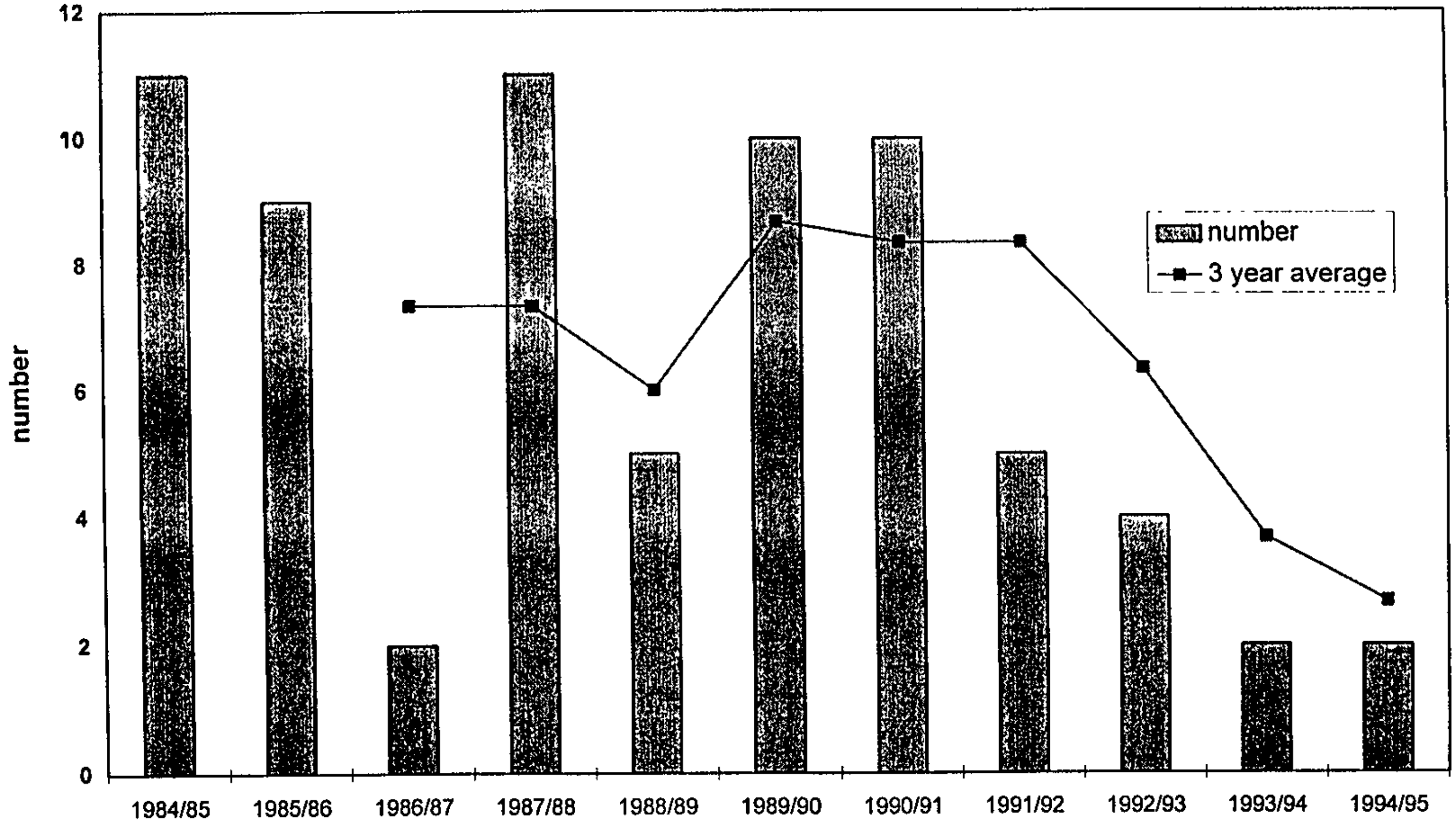
* TO CHARACTERISE THE IMPORTANT AND RECURRING FEATURES OF ACCIDENTS

WINDOW SOFTWARE PROGRAM

ROOT CAUSES

TRENDS ETC.

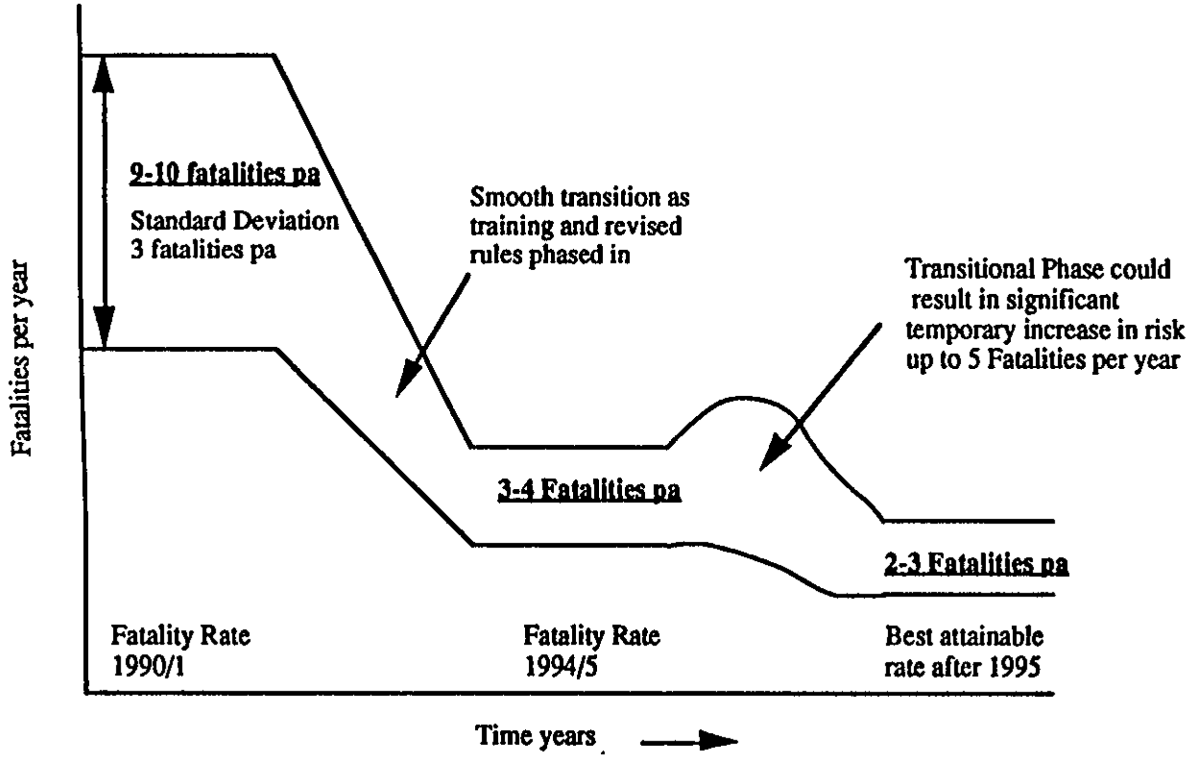
Trackside workers struck by train
(1984/5 - 1994/5)



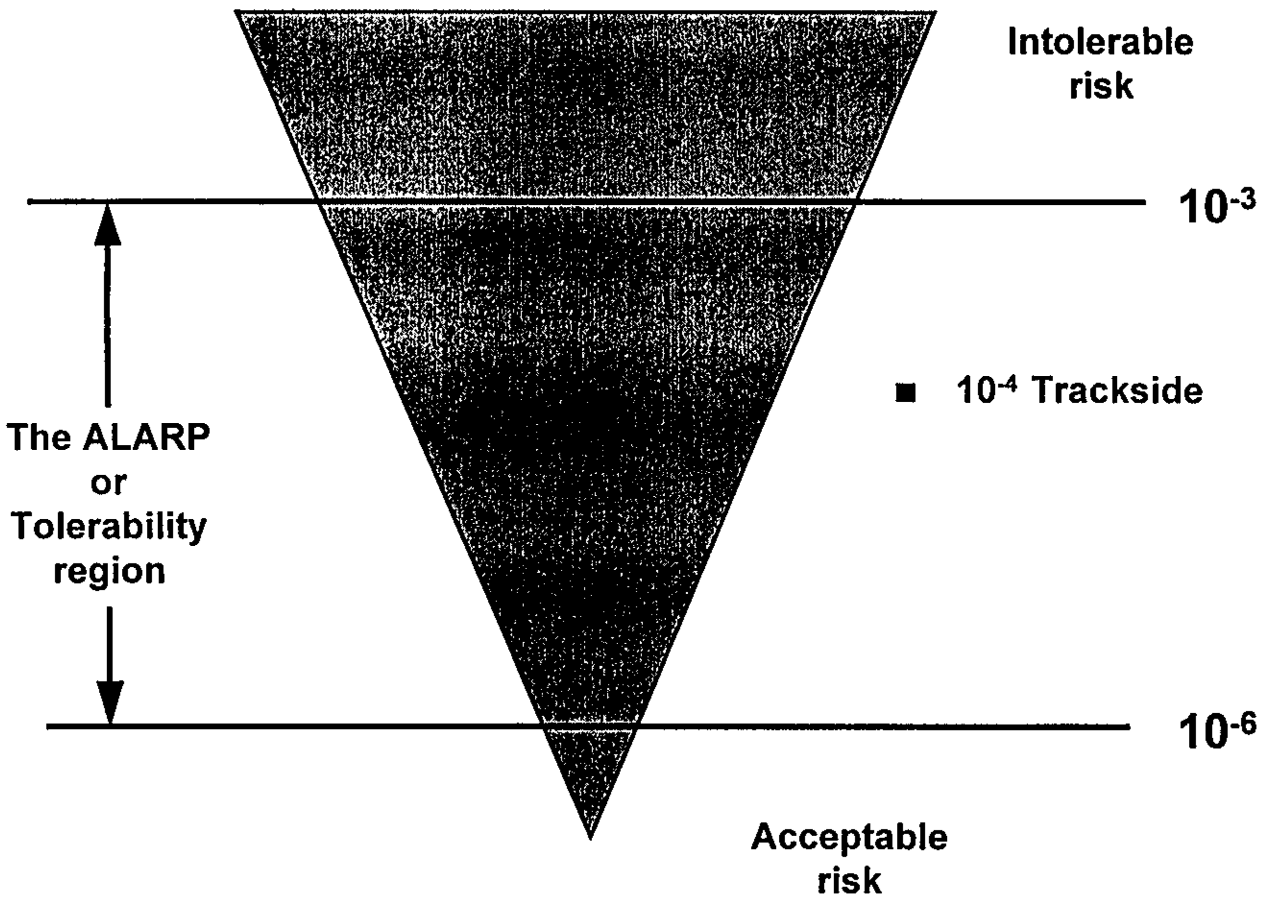
June 1995

Main findings of the study : Risk Assessment results

The Risk Assessment suggests that the 1992 initiatives should have reduced annual fatality levels from about 9 fatalities to 3-4. If the 1995 changes are fully implemented, further reduction to annual levels of 2-3 fatalities should be achieved.



ALARP and Current Trackside Risk



Intolerable
risk

10^{-3}

■ 10^{-4} Trackside

The ALARP
or
Tolerability
region

10^{-6}

Acceptable
risk

WHERE TO FROM HERE

- I IN 10,000 SUSTAINED BY 1998
- CANNOT BE COMPLACENT - NEAR MISSES CONTINUE
- WORKING ALONE
- CONTRACTORS
- COMMUNICATIONS
- RAIT

CONCLUSIONS

* A FOCUSSED PROJECT HAS BEEN A MAJOR CONTRIBUTOR TO IMPOVED TRACKSIDE SAFETY PERFORMANCE
* BUT CANNOT BE COMPLACENT
  - COMMUNICATIONS
  - HUMAN FACTORS INITIATIVES
  - MANAGING INTERFACES
* CONSOLIDATION

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Muneaki Ogata

Our Creative Safety Measures Aiming at Zero Accident

Publisher
2000 International Rail Safety Conference

III/4 Muneaki Ogata

Our creative Safety Measures - Aiming at zero Accident

INTERNATIONAL RAILWAY SAFETY SEMINAR, 9 – 11 OCTOBER 1995, MAINZ

Our creative safety measures – Aiming at zero accident

By

Mr Muneaki Ogata

East Japan Railway Workers' Union

1, Introduction

I appreciate having an oppotunity to talk with experts from all over the world about our accident preventive measures and concept .

I work for a maintenace depot and work on tracks, accidents where workers are hit by moving trains, which we call "hit–by–train accident", are inevitably our big concerns. There was no death accident in East Japan Railway last year for the first time since it started business in 1987. However, regrettably, a tragic accident occured this May. One of our colleagues was hit by train runing on the next tracks of his and killed. Despite our effort to prevent hit–by–train accidents pricious life was claimed again.

I would like to report on our recent experience as a front line worker. I also tell you what the trade union should and can do to develop railway safety.

2, Our working envirnment

First of all, I would like to explain our working envirnment. There are two types of railway line in East Japan Railway. One is Shinkansen and the other is exsisting normal lines. The former is well–known high–speed railway system, which has become a mainstream of passenger trafic in Japan. The latter is a nation–wide network, which has contributed to the development of modern Japanese transportation since its start of 1873.

There are big differences in structure and maintenance method between two lines. The tracks of Shinkansen are 1435 mm wide and have no level crossing, running over motor roads. Beside Shinkansen has adopted "time zone maintenance" method. Track workers only work during the time when train are not running. It has a concept to seperate maintenance time from train running time.

However, the normal lines, whose width is 1067 mm, do not adopt the same method of Shinkansen. Workers have to work between the intervals of train operation. We call it "interval maintenance" *method.*

In this talk I will refer to safety issues of the latter system.

1) Train's Speed: is regulated in each line, trains run at 80 to 130 km/h.

2) Timetable and interval: set in every 15 minutes. This is an example of one of the second grade railway tracks. Tracks are ranked four grades in Japan. As you can see, regarding this tracks we have to work during the intervals of 10 to 40 minutes in day time and two to three hours at night.

3) Maintenance work : Recently we can do maintenance work and inspect tracks with big machines. However, since facilities of tracks cannot catch up with modernisation, there still have been many jobs done by manpower, especially in day time, as we usually use big machines at night.

3, Fatal accident and safety measures

Eight years has passed since East Japan Railway set up in 1987. Since then 66 fatal accidents occured. They claimed 74 lives of employees of JR East Railway and sub–contracted companies. 61 out of 74 people (82 %) and 53 out of 66 accidents (80 %) are related to track and electricty workers. On the whole accidents were decreasing and it was first time that we had recorded no accident last year.

Regarding causes of fatal accidents since 1987, hit–by–train comes first, fall second and electric shock third. 31 hit–by–train accidents occered (46 %) and 39 people died (52 %).

Number of fatal accidents (April 1987 – July 1995 ficical year)

	1987	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*total*
hit–by–train	5	6	5	4	1	6	3		1	31
fall	2	3	3	3	1	1	3	1		17
elect.shock	1		2	2		1			1	7
others		1	5		1	1	1	2		11
total	8	10	15	9	3	9	7	3	2	66

We focused on hit–by–train accidents. The causes of those are follows:

1) *isolated alone without a lookout man*
2) *unappropriated placement of lookout men*
3) *communication error*
4) *work without lookout men*
5) *reading error of train timetable*
6) *wrong conviction of the train schdule due to no reconfirmation of timetable*

We examined rules, checked up the facilities and learnt lessons through these acctivities. Then, we proposed concreat safety measures to the company. After a while the company announced the measures to tackle, from both sides: software and hardware.

< Software >

1) *renew the manual of hit–by–train accident prevention*
2) *start of "Challenge Safety Compaign"*
3) *meetings and forums on railway safety sponsored by the company*

< Hardware >

1) *movable special signal light equipment*
2) *track short circuit device*
3) *handy wireless telephone*
4) *devices to detect approchning trains*
5) *to shift mantenance and inspection from manpower to machine*

4, Workers' initiative for safety

1) Our starting point

We, as work–site workers, discussed accident preventive measures on every occasions. Especially, we examined fatal accidents seriously. At the begining of our discussion, we confirmed that we must protect our pricious lives first. Workers sell their labour to gain wages but will not sell their lives. We do not work at the risk of our lives.

Therefore, it is clear that for trade union safety is as important as other working conditions, such as wages and working hours. Neverthless, trade unions of JNR era had not dealt with it seriously, so, *at first we had difficulties to take initiative until we were able to stand at the starting point.*

In workplace we tend to compromise the reality of safety matters. We know safty is important. However, it is very difficult for us to see it as urgent problems. We can hardly feel risky in a daily work and take it for granted that we can finish it safely. It is natural human nature to tend to think,"Yesterday and today were safe, so, tommorrow will be the same, nothing must be happening at least to me."

Although I do not know exactly what rate it is, the propability involved in accidents is low. However, we give up tackling this issue propability of the fatal accident will absolutely increase. Life is so precious that we aim at "zero accident" in practical.

2) Ambivalent feelings

Although the hit–by–train accidents have been decreasing, it is unlikely to be eliminated at all. We have to question to ourselves why those accidents continue to happen.

There are roughly two causes of the accidents; human factors, and other aspects such as surroundings and instruments or machines. At the moment accidents caused by human factors are increasing at the work–sites. The rules for preventing hit–by–train accidents have been altered to improve rules. As regarding to the hardware, an alarm and other equipment have been invented and put into practice. Nevertheless, accidents have been occurring, although in low ratio. Without analyzing why this situation maintains, we could not eradicate accidents.

When we work in the front line, we are in a dilemma, the dilemma between the feelings; "I should never break the rules" and "I want to accomplish the job perfectly". Naturally we are proud of our job and responsible for it too. When we carry out our tasks, we always think of maintaining tracks as good as possible and achieving the jobs as effectively as possible. At the same time we must follow the rules in order to prevent accidents.

Generally speaking, we human beings have diligence to do the best for fulfilling the task, and at the same time laziness not to do troublesome jobs, even though we know we must. I will take two examples of this aspect from the work–site.

1) carrying out the operation without arranging lookout men, because, in order to arrange lookout men the number of the operation group are cut and it effects on efficiency. In other words, putting priority on effectiveness.

2) Halting the operation of the day for the sake of workers' safety, when one of the three lookout men required on the plan cannot turn up for some urgent reasons. In other words, putting priority *on safety and changing the schedule. Of course we must take the second way to keep the rules, but it is difficult to do in reality.*

I think that it depends on national characters and environments which way of the two examples people take. Reflecting upon this, most Japanese including me will behave like the first one. It might be difficult for non–Japanese to understand.

(3) Safety should be tackled by the joint effort of labour and management

We reckon that safety is only achieved by a cooperation of labour and management with hurdling the boundary between them. For instance, even if the company implements as safe machine as possible, it will not be effectively worked when workers cannot deal with it. I am afraid it can also be said that if we make as good rules as possible, they mean nothing without our keeping them and this could result another accident.

Accidents take place in the work–sites. This suggests that solutions to preven accidents can be found only in the work–sites. Rules which workers in the front line can actually get at are the practical rules to block accidents from happening. It is simple. If we are willing to listen to wisdom gained in the spot, the way will be spontaneously shown.

JR East company proposed a campaign named "Challenge Safety" in September 1988. Safety director at the time explained the concept of the campaign as follows;

Up to now our image of safety has been negative. But from now on we will challenge to create safety. Analyzing and discussing what the tasks for securing safety through routine activities, we put into practice what we get from the situation. In other words, our aim is to build a safety system beforehand. To secure safety, I will ask the front–liners who face safety problems everyday to think what is the most important subject on safety. On this base we will tackle to create safety beforehand.

We suppose that this clearly shows how JR East put priority on the initiative of the front line workers regarding safety. Agreeing basically to this view, we have been participating the campaign so called "Challenge Safety"

It might be minor issues for the experts, but we took an initiative in organizing discussions about safety in the site. Sometimes boiling argument did not finish even after working time was over. We are proud ourselves of being professional of safety in reality, although we are not familiar with complicated theories. However we refine and improve "software"–rules or procedures and hardware, it is human beings who apply them to the real situation. Human who can link "software" to "hardware" is substantial. It is man who make rules and follows them. Therefore there is no border *between labour and management in this area. Safety cannot be fulfilled if rule—makers and performers have different ideas.*

5. Conclusion

"Railway is a human way" is our union's belief. We have carried out the safety campaign on the ground of the importance of human life in every area. With cooperation of labour and management, we confirmed with the company that we were determined not to let a terrible accident happen again, issuing Safety Declaration in November 1994.

The number of deaths from accidents has been steadily declining. Still, there have been many potential death accidents which just happened to be a lucky escape by coincidence. The decline means that safety measures taken constantly prevented those accidents. On the other hand, the fact that there have been many buds to death accidents can also be interpreted that we still have problems ahead.

We have to build safe working place by demanding whatever we need in order to protect our lives, with strong determination to secure work place as the trade union. We do not want such a tragic accident to happen again.

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Dr K. Hauser

Safety at Work

Publisher
2000 International Rail Safety Conference

III/5 **Dr. K. Hauser**

Safety at Work

International Railway Safety Seminar 1995
09 - 11 October, in Mainz / Germany
Paper presented by: K.Hauser,SBB

INDUSTRIAL SAFETY

1. Introduction

The project "Improved industrial safety at the SBB" was triggered by the massive premium increase of more than 2 million Swiss francs per year for accident insurance, following continuously increased accident costs at the SBB (number of non-productive days because of an occupational or non-occupational accident).

Foil1 occupational accidents 93

Independent from that, an internal study was carried out in consequence of a tightening of the regulations of the new legal ordinance on accident prevention. This study brought to light the inefficiency of the present organisation for occupational safety.

Foil 2 SBB in internat. comparison

Foil 3 objectives

Foil 4 costs 1993

This situation prompted the management to start a project for the improvement of occupational safety. Also an expert from outside the SBB was called in.
The project's objectives are:

- to considerably reduce the number of accidents at the SBB, and thus to:
    - safeguard and further the physical and mental integrity of staff;
    - to increase availability at the place of work;
    - reduce costs through a synergy effect.
- to improve the image of the SBB as:
    - a safe and reliable means of transportation;
    - employer with safe places of work.

1.1 Objective of the presentation

The presentation shall show the SBB's approach to the big problem of improving safety at all work places, and what has been achieved so far. It shall show in particular, what new findings it was possible to gather.

2 The Project " Improved occupational safety at the SBB"

Based on the results of the mentioned internal study, the management gave orders to carry out a detailed study that should show how to improve the situation, and sanctioned the calling in of help from the firm SEMS/DuPont.

2.1 Project organisation

In order to give the project the necessary force of impact, it was placed under the direct responsibility of a general director, who instituted a committee composed of the three regional directors, the directors of those departments most concerned, and the overall management of the project. To this committee are subordinated the overall project management, the leaders of the part-projects of the regional managements and of the workshops

Foil 5 Project Organisation

2.2 Course of action of the project

In a first step, the top management held a seminar and was confronted with a presentation of the present situation as worked out in the preliminary study, with the new philosophy concerning safety, and with the potential for success of the firm DuPont

Subsequently, a pilot study was started in one of the three regions with the aim later to include the two other regions and the workshops.

Together with the experts, the course of action of the pilot study was defined as follows:

Phase 1:

- Taking stock of the present situation by the experts, analysis of the worked-out results and drawing up of a report for the hands of the steering authority;

- Discussion of the report with the responsible leaders of the concerned services, and explanation of the findings;

- Working out of a catalogue of measures to improve the situation,

- Implementation of the catalogue of measures by the responsible leaders of the different services, after attending training courses in phases 2 and 3.

Phase 2:

- Training of the top and middle management by the experts with the objective to explain the experts' philosophy, and to integrate it into the SBB as a new way of thinking.

- Bringing to light the necessary prerequisites for the implementation of the new "Sicherheitskultur" (Safety culture) (prerequisites for a successful safety management)

Foil 6 Safety management

Phase 3:

- Training of the top and middle management by the experts with the objective to explain the techniques of the safety audits in the line managements SBB-wide.

Phase 4:

- At the earliest 6 months after termination of the audit trainings, a new stocktaking and evaluation of the current situation is carried out by the experts
  The ensuing report shall show whether the philosophy has been understood and applied correctly, and whether the measures for improvement have brought any results.

The phases 1 to 3 are terminated. Phase 4 will start towards the end of 1995

3 Stocktaking and analysis

The pilot project was started as planned. Very soon it became clear that in the same company, one cannot work with "different safeties and varying philosophies" Therefore the steering authority decided to immediately extend the studies to all other services.

31 Findings

The first findings were sobering. The listed-up improvement measures did not contain novel things not already known in theory. One had to ask oneself however, why all this had not been implemented and been applied long before

This question led to the following precepts, without which a safe working cannot be guaranteed:

Foil 7 core statements

- Safe working presupposes a favourable attitude (safety culture); in other words it begins in the head of each employee.

- Occupational safety is a production factor, equivalent to efficiency and quality

- Safe working entirely and completely depends on the dedication and the good example of the line managers on all levels (safety must be lived). The commitment of the line to safe methods is reflected in the safety audits carried out regularly.

- Safe working is a management task, and therefore a permanent point in the agenda of management reports. In order that it is possible to lead, the necessary basics (structures, information flows and processes) must be created.

- Safe working presupposes a two-way communication, meaning that the superiors must immediately react to reported possibilities of improvement (audit results).

- Safe working needs a permanent education of all concerned. The education must be given to all managers down to the lowest management level.

32 Catalogue of measures

The measures of improvement proposed for the different service fields are combined to a bundle of measures that is now being implemented. These measures can be summarized roughly as follows:

Foil 8 bundle of measures
Foil 9 implementation

- Six bundles (=part projects) for a better management in the field of occupational safety.

- Nine bundles to meet the organisational basic requirements for safe working.

- One bundle to build up a permanent education in the field of safety (not only occupational safety).

- Two bundles for the working out of the necessary indicator figures for management and for the statistics.

- One bundle for the regulation of relations with third party companies that work in danger zones ot railway traffic.

- One bundle for the realisation of local improvement measures.

33 Implementation

To speed up the project, the steering authority decided to introduce a bundle of immediate measures, constituting the preconditions for the measures to implement later.
The implementation of the measures lies in the responsibility of the line and is carried out by SBB's own specialists.
The most important ones of the measures already put into practice are:

Foil 10 immediate measures

- The new ocupational safety policy, derived from the new philosophy, is in force.

- The communication concept for the propagation of the new philosophy stands, and is now being implemented.

Foil 11 pictogramme

- The training of the top and middle management is terminated SBB-wide; the training of the lowest management level is currently in preparation.

- The build-up of the organisational preconditions (structures, information flows and processes) is now under way; the major steering bodies in the regional managements are constituted, the carrying out of audits has begun.

- The collection of data of accidents and incidents is built up; the statistical evaluations are published monthly and are used as key management figures.

4 Effects

The project was started in June 1994 as a pilot project in one of the regional managements. Already today, statistical figures point to an improvement as regards numbers of accidents.

Foil 12 statistics of accidents

For the coordination of the training in the field of safety, until today separately done in each department of the company, a new post in the Principal Department for Safety was created. The first task of this post is to prepare and to carry out the training for the lowest management level.

5 Recapitulation

A study at the SBB revealed that the control of occupational safety was organised inefficiently, and that the numbers of accidents and their costs were very high compared to other railways.

A multi-phased project for the improvement of occupational safety was realised, with the help of the firm SEMS/DuPont. The emphasis lies in the introduction of a new safety culture and the necessary training on all levels of the hierarchy.

To introduce a new thinking in the field of safety, a strong commitment of the line managers on all levels is an absolute must. The good example of the superior is the best motivation.

The providing of the necessary structures, information flows and processes and their instruments is compulsory.

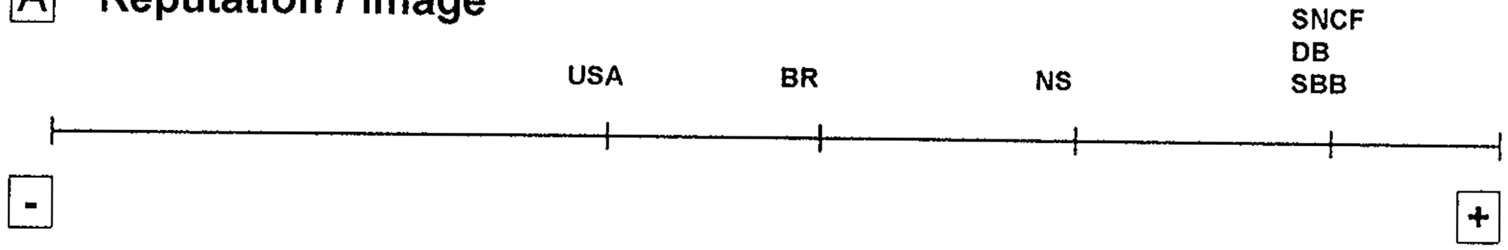
First results in terms of reaching the goals, can be made out already after the first six months.

Occupational accidents 1993

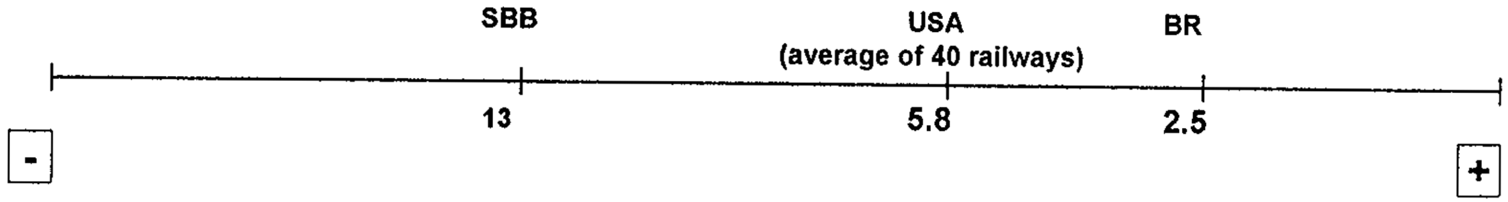
	Number of accidents	Workdays lost
Central services	43	439
Construction services	666	11734
Operating services	2378	39747
Traction services	678	7039
Workshops	468	6926
Power plants	22	299
Total	4255	66224

SBB in international comparison

A Reputation / Image



B Occupational safety (per 100 employees and year)



The comparison shows

- The SBB have too high accident figures
- A drastic improvement is necessary and realistic

Objectives

- Reduction of the number of accidents at the SBB and thus:
  - to safeguard and to further the physical and mental well-being of our employees
  - to increase availability at the place of work
  - as synergy effect: to save costs
- Promotion of SBB`s image as:
  - a safe and reliable transportation enterprise
  - employer with safe places of work

Occupational accidents and illnesses (BU + BK)

Total direct costs BU + BK = 53 million sFr

Indirect costs = approx. 2.5 x direct costs = 128 million sFr

Non occupational, resp, leisure time accidents (NBU)

Total direct costs NBU = 61 million sFr

indirect costs = approx. 2.5x direct costs = 153 million sFr

The total costs per year for the SBB amount to approx. = 395 million sFr

(according to statistical data of the Swiss accident insurance agency 1990)

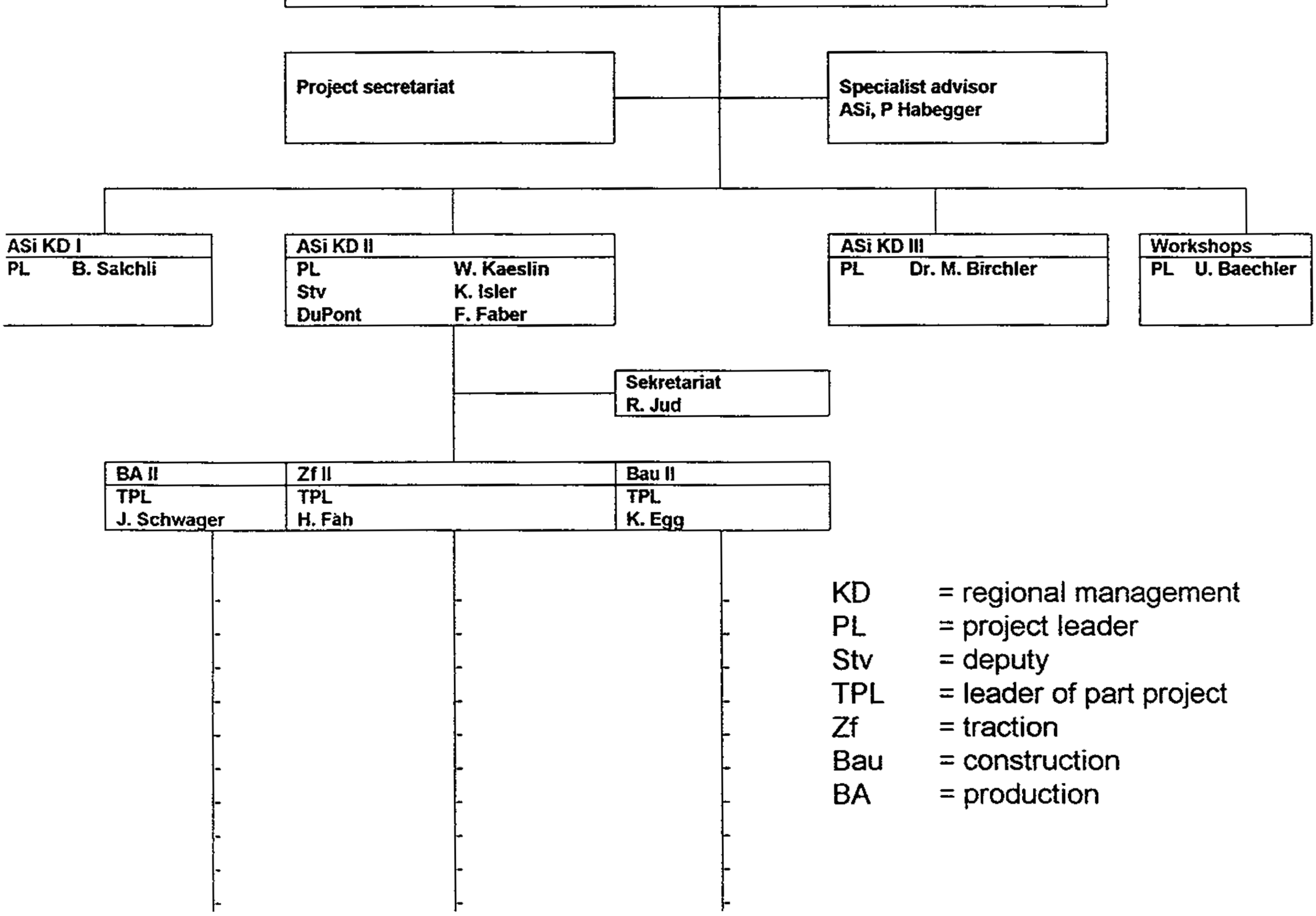
New occupational safety at the SBB: ZSA

ZSA = Central safety committee

2. Dept. : GD Fagagnini, Vorsitz
KD I : P.A Urech
KD II : H. K. Dick
KD III : E. Rutishauser
BA GD : J. Eberle
ZfW : Th. Weiss
Bau GD : Dr. P. Winter
S : Dr. K. Hauser (bis 31.05.95)
H.P. Hadorn (ab 1.06.95)

Projekt:New occupational safety at the SBB

S : Dr. K. Hauser, GPL (H.P. Hadorn)
KD I : B. Salchli PL KD I
KD II : W. Kaeslin PL KD II
KD II : Dr. M. Birchler PL KD III
Werkstätten : U. Bächler PL ZfW
DuPont : F. Faber
C. Vanderdonckt



Project secretariat

Specialist advisor
ASi, P Habegger

ASi KD I
PL B. Salchli

ASi KD II
PL W. Kaeslin
Stv K. Isler
DuPont F. Faber

ASi KD III
PL Dr. M. Birchler

Workshops
PL U. Baechler

Sekretariat
R. Jud

BA II
TPL
J. Schwager

Zf II
TPL
H. Fàh

Bau II
TPL
K. Egg

KD = regional management
PL = project leader
Stv = deputy
TPL = leader of part project
Zf = traction
Bau = construction
BA = production

REQUIREMENTS FOR A SUCCESSFUL SAFETY MANAGEMENT

1 TARGET-ORIENTED COMMITMENT OF THE MANAGEMENT

2. SAFETY CONCEPT

3. ORGANISATION OF SAFETY

4. RESPONSIBILITIES OF THE LINE ORGANISATION

5. FAR-REACHING GOALS AND TASK-SETTINGS OF THE COMPANY'S SAFETY POLICY

6. HIGH SECURITY STANDARDS

7. SUPPORT BY INDUSTRIAL SAFETY SPECIALISTS

8. COMPREHENSIVE ACCIDENT INVESTIGATION AND REPORTING, AS WELL AS INICIDENT REPORTING

9. MODERN MOTIVATION METHODS

10. EFFICIENT TWO-WAY COMMUNICATION

11. PEMANENT EDUCATION IN SAFETY

12. EFFECTIVE INSPECTIONS AND AUDITS

CORE STATEMENTS

- Safe working presupposes a favourable attitude (safety culture); in other words it begins in the head of each employee.
- Occupational safety is a production factor, equivalent to efficiency and quality.
- Safe working entirely and completely depends on the dedication and the good example of the line managers on all levels (safety must be lived). The commitment of the line to safe methods is reflected in the safety audits carried out regularly.
- Safe working is a management task, and therefore a permanent point in the agenda of management reports. In order that it is possible to lead, the necessary basics (structures, information flows and processes) must be created.
- Safe working presupposes a two-way communication, meaning that the superiors must immediately react to reported potential for improvement (audit results).
- Safe working needs a permanent education of all concerned.
  The education must be given to all managers down to the lowest management level.

IMPROVED INDUSTRIAL SAFETY AT THE SBB: BUNDLES OF MEASURES

A1	Management	Safety objectives as a management task
A2		Behaviour of the superior
A3		Prevention of unsafe acts and situations
A4		Enforcing that protections items are used
A5		Enforcing of guidance for safe working
A6		Safety inspections (audits)
B1	Organisation	Build-up of the Central Safety Committees
B2		Build-up of structures SBB-wide
B3		Build-up of information flows
B4		Updating of working papers and means
B5		Updating of regulations/prescriptions
B6		Preventive measures for the deployment of labour
B7		Preventive measures for the deployment of tools
B8		Adjustments to be made at staff qualification system
B9		Adjustments to be made to the suggestion scheme
C1	Education	Basic training an permanent education
D1	Statistics	Registration of accidents and clarification of causes
D2		Compiling of statistics of industrial accidents
E1	Contractors	Definition of relations with third party companies
F1	Local measures	Realisation of local improvement measures

Verbesserte Arbeitssicherheit bei den SBB

Massnahmen - Katalog

Nummer	Wir-kung	Prio-rität	Massnahmen - Titel	Massnahmen - Beschreibung	verantwort	Umsetzung	Termin	eingeleitet	umgesetzt
1			**Engagement des Managements**						
2 1-1	C	2	ASi im Geschäftsbericht darstellen	Arbeitssicherheit ist Teil des SBB-weiten Sicherheitsdenkens und daher im Geschäftsbericht darzustellen	GPL / GS		31.12.95		
2 1-2	A	1	Sicherheit als Thema in Besprechungen	In jeder passenden Besprechung wird das Thema Sicherheit regelmässig behandelt	GPL / GD PL / TPL / HA KD	Schulung, Beispiel 'von oben'	1.01.95	1 01 95	
2 1-3	A	1	Sicherheitsbegehungen durch jeden Vorgesetzten	veranlassen, dass jeder (Linien-?)Vorgesetzte regelmässig Sicherheitsbegehungen durchführt	PL / TPL / HA KD	Schulung durch Audit-Training-Seminare, Weisung der Abteilungen, Kontrolle der Durchführung	1.07 95		
2 1-4	A	1	Für Einhaltung der Vorschriften sorgen	jeder Vorgesetzte sorgt dafür, dass Vorschriften über Sicherheit immer eingehalten werden	PL / TPL / HA KD	Schulung, regelmässige Audits, Auswertung von Unfällen, Haltung/Beispiel/Personalqualifikation/ Disziplinarmassnahmen (siehe auch M 4-15 und 12-3)	1.07.95		
2 1-5	A	2	Sicheres Verhalten als Kriterium in Personalqualifikation	sicheres Verhalten aller Mitarbeiter ist als Bewertungskriterium in die Personalqualifikation aufzunehmen	GPL / PA	PA erhält Auftrag, die PQ-Formulare anzupassen, (siehe auch M 5-14)	1.10 95		
3 1-6	A	1	Haltung der GD auf die Kader übertragen		GPL / PL	Arbeitssicherheits-Politik 'top down' kommunizieren (Massnahme 2-1)	1.05 95		
2 1-7	A	1	Verhalten der Vorgesetzten	Sicherheitsvorschriften gelten auch für Vorgesetzte, sie haben sich daher entsprechend zu verhalten	PL / TPL / HA KD	Schulung, Audits, Inspektionen, (siehe auch M 6-3, 4-13)			
2 1-8	A	1	Tragen der Warnweste durchsetzen	das Tragen der Warnweste im Gleisbereich ist durchzusetzen	GPL / GD / PL / TPL / HA KD	siehe auch M 4-12, 4-13, 13-21 bis 24	1 07 95		
3 1-9	A	1	Fur Durchschlupfen zwischen fahrenden Wagen Disziplinar-Massnahmen androhen	für das Durchschlüpfen zwischen fahrenden Wagen durch schriftliche Weisung Disziplinarmassnahmen androhen und bei Wiederholung durchführen	PL / TPL / HA KD		1.07.95		
3 1-10	B	1	Verpflichtungen der Werkverträge durchsetzen	die Verpflichtungen der Werkverträge und der Ausführungsvorschriften, nebst den Weisungen in den ausgehändigten Dokumenten, auf den Baustellen der Vertragsfirmen durchsetzen	TPL / Bau KD / Baust-Si	Schulung, Audits, Inspektionen, siehe Baustellensicherheit M 17/19 Umsetzung eingeleitet	1.10 95	15 06 95	
3 1-11	B	2	Bei Verstössen rechtliche Schritte gegen Vertragsfirmen einleiten	wenn immer wieder Verstösse auftreten, rechtliche Schritte gegen Vertragsfirmen einleiten und nötigenfalls die Werkverträge aus wichtigem Grund fristlos kündigen	TPL / Bau KD / Baust-Si	klare Vorgaben , Schulung, Audits, Inspektionen, siehe auch Baustellensicherheit M 19	1 10.95		

Improved industrial safety at the SBB

Catalogue of measures

Nr Rate Priority Measure Description of measure Responsible Implementation
Deadline initiated realised

1 Commitment of the management

2.1-1 Industrial safety is item in annual business report

Industrial safety is part of the SBB-wide concern for safety, and must therefore be included in the annual business report

2.1-2 Safety is item on agenda of business conferences

In each relevant conference, the theme of safety is taken up regularly

Training, good example "from above"

2 1-3 Safety audits at worksites by each superior

to arrange that each line manager regularly carries out safety audits

Audit training seminars order from department heads, control if executed

2.1-4 To make certain that rules are respected

Each superior makes certain that regulations on safety are always followed

training regular audits, evaluation of accidents; attitudes/example/staff qualification/disciplinary measures (see also 4-15 and 12-3)

2.1-5 Observation of safety rules as criterion in staff qualification

A safe conduct of all employees is to be a criterion in the merit rating and must be taken on as a point in the staff qualification forms.

Personnel department receives orders to change the forms (see also 5-14)

3.1-6 Attitude of the general directors to be transmitted to all executives

-

Policy of industrial safety must be communicated "top-down" (measure 2-1)

2.1-7 Attitude of the superiors

Safety rules apply also to superiors. They have therefore to act accordingly.

Training, audits, inspections (see als 6-3, 4-13)

2.1-8 Wearing of warning vest must be enforced

The warning vest must be worn in track areas. This must be enforced.

see also 4-12, 4-13, 13-21 to 24

3.1-9 For slipping shrough between moving cars, culprits must be threatened with disciplinary measures

By written directive, disciplinary measures must be threatened in case someone slips through between moving cars If repeated, such measures are carried out

-

3.1-10 Fulfilling of obligations in work contract must be enforced

The carrying out of obligations by the contractors in the work contracts and the application rules, besides the prescriptions in the documents handed over at the construction sites, must be enforced

Training, audits, inspections. See construction site safety, measures 17/19 Implementation has started

3.1-11 In case of violations legal action is started against contractor.

If repeated violations occur, legal action is taken against contractor, and if necessary the work contract is terminated for serious reasons and without notice

Clear instructions, training, audits inspections. See also construction site safety, measure 19

IMMEDIATE MEASURES

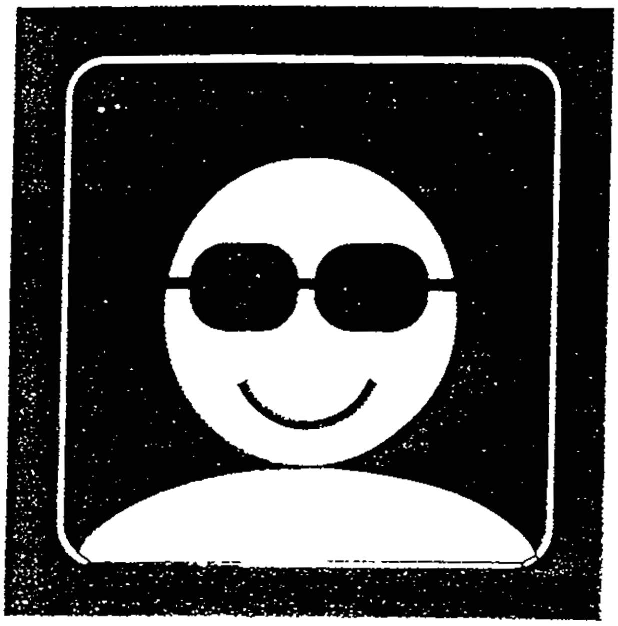
- Establishment of a Central Safety Committee at the top management level

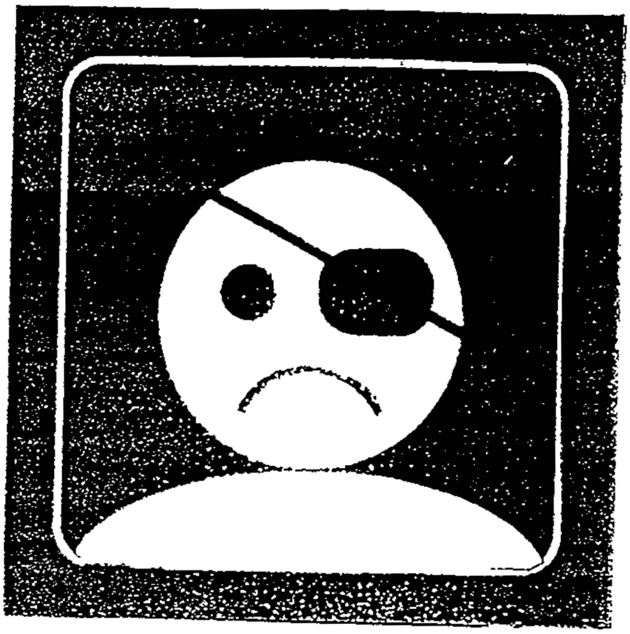
- Definition of the policy of industrial safety as a part of SBB's safety policy

- Communication of the SBB's policy of industrial safety
  - internally
  - outside the company

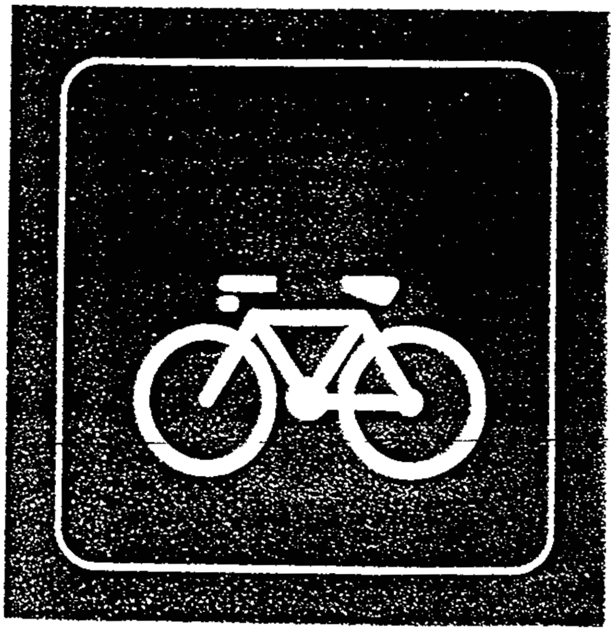
- Build-up of an efficient and powerful safety organisation

- Definition of the first tasks of the Central Safety Committee
  - Policy of industrial safety
  - Objectives 1996 for industrial safety
  - Statistics
  - Safety programme 1996





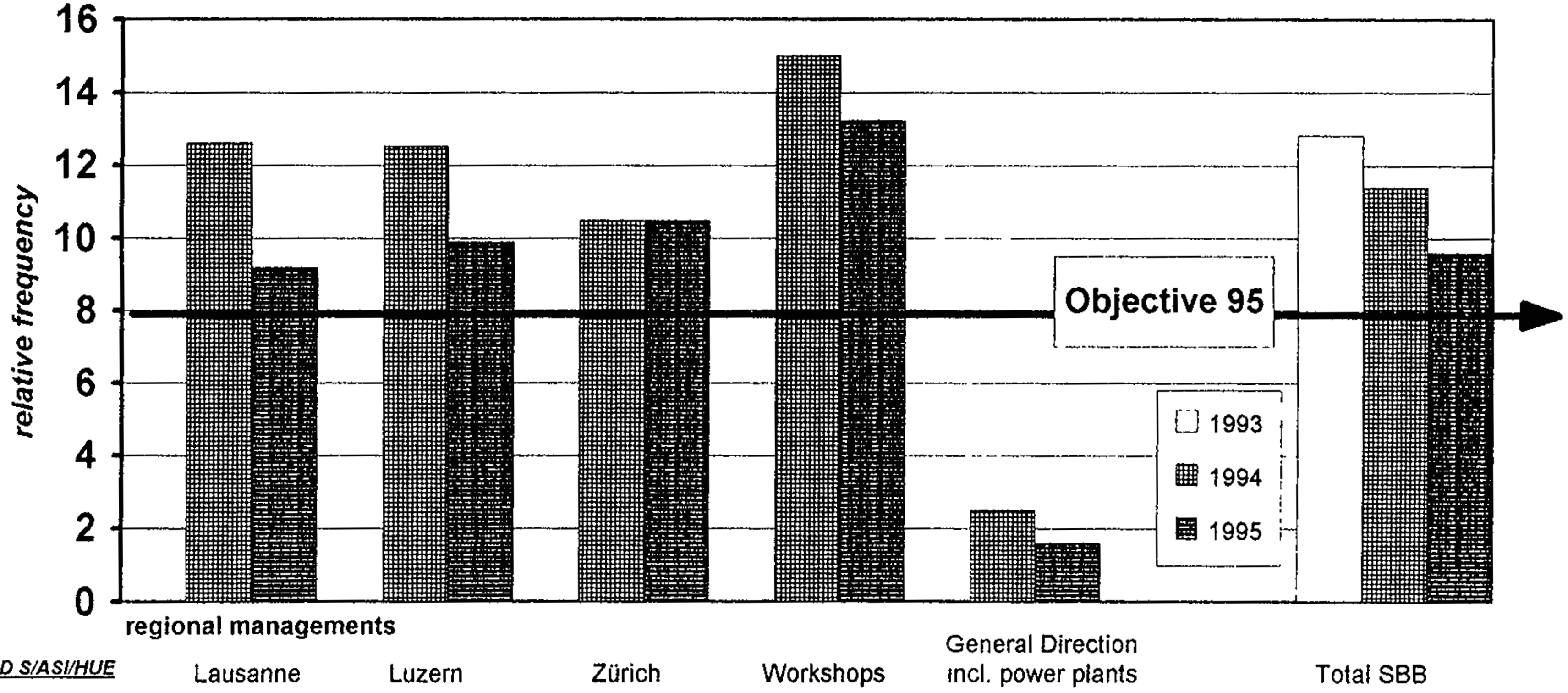
SBB CFF FFS



SBB CFF FFS

Mit Sicherheit
SBB CFF FFS

Development of industrial accidents [relative frequency = accidents per 100 persons per year



GD S/ASI/HUE

International Rail
Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9518

Ernest C. Hung

Combine (Quality and Safety) Audit

Publisher
2000 International Rail Safety Conference

IV/1 **Ernest C.F. Hung**

Combine (Quality & Safety) Audit

Topic: Combine (Quality & Safety) Audit

Presented by: Ernest C.F. Hung

Hong Kong Mass Transit Railway Corporation

Venue: International Railway Safety Seminar 1995

1. **What is Audit?**

2. **Why we need Audit?**

3. **How Audit can provide?**

4. **Who should involve in the Audit?**

5. **What is combine Audit?**

What is Audit?

- * management tools - to determining the effectiveness
- * check compliance and identifying areas of improvements

Type of Audit

Audit Types	Quality	Safety	Environmental	Financial
Internal	✓	✓	✓	✓
External	✓	✓	✓	✓

Parties Involve Audit

Auditor

Auditee

Type of Audit Performance in Operation Engineering Department

	Quality	Safety
Internal Audit	✓	✓
External Audit	✓	✓

In MTRC, the Operation Engineering Department only conduct Quality and Safety Audit for Operational Railway at this stage.

Combine (Quality & Safety) Audit Approach

Strategy & Focus

- **ISO 9000 Quality System**
- **Safety Manual, developed 15 Safety Protocol task**

QUALITY & SAFETY AUDIT DETAILS

1. DEFINE ANNUAL QUALITY AND SAFETY AUDIT PLAN (QAM/SAM)

Design a 3 year Quality & Safety Audit Programme for all OED sections.

2. I) DEFINE SAFETY AUDIT SCOPE AND PREPARE PROTOCOLS (QAM/SAM/WORK GROUP MANAGER)

II) DEFINE QUALITY AUDIT SCOPE (BASED ON ISO 9000) (QAM)

Review and agree upon the Safety audit scope. Then, review the audit checklist data bank, and select questions for use.

3. ASSIGN AUDIT TEAM (QSM/QAM - YEAR 1,2 SSM/SAM - YEAR 3)

Determine required interviewees and coordinator with the Work Group Manager, then setup timetable, and formally issue the audit checklists to the auditee for information.

4. I) PREPARE AUDIT SCHEDULE AND DETAILS (AUDIT TEAM/WORK GROUP MANAGER)

II) SEND PROTOCOLS TO AUDITEE FOR INFORMATION (AUDIT TEAM)

During the on-site assessment, both the documentation adequacy and implementation effectiveness are both assessed. All audit findings are recorded in the checklist. Then after the interviews, the % of compliance would be calculated. Also, CARs are prepared to highlight the non-conformance, and present to the auditee for acknowledgement.

5. CONDUCT AUDIT

- **OPENING MEETING**
- **AUDIT EXECUTION**
- **SCORE DETERMINATION**
- **CLOSING MEETING**

(AUDIT TEAM)

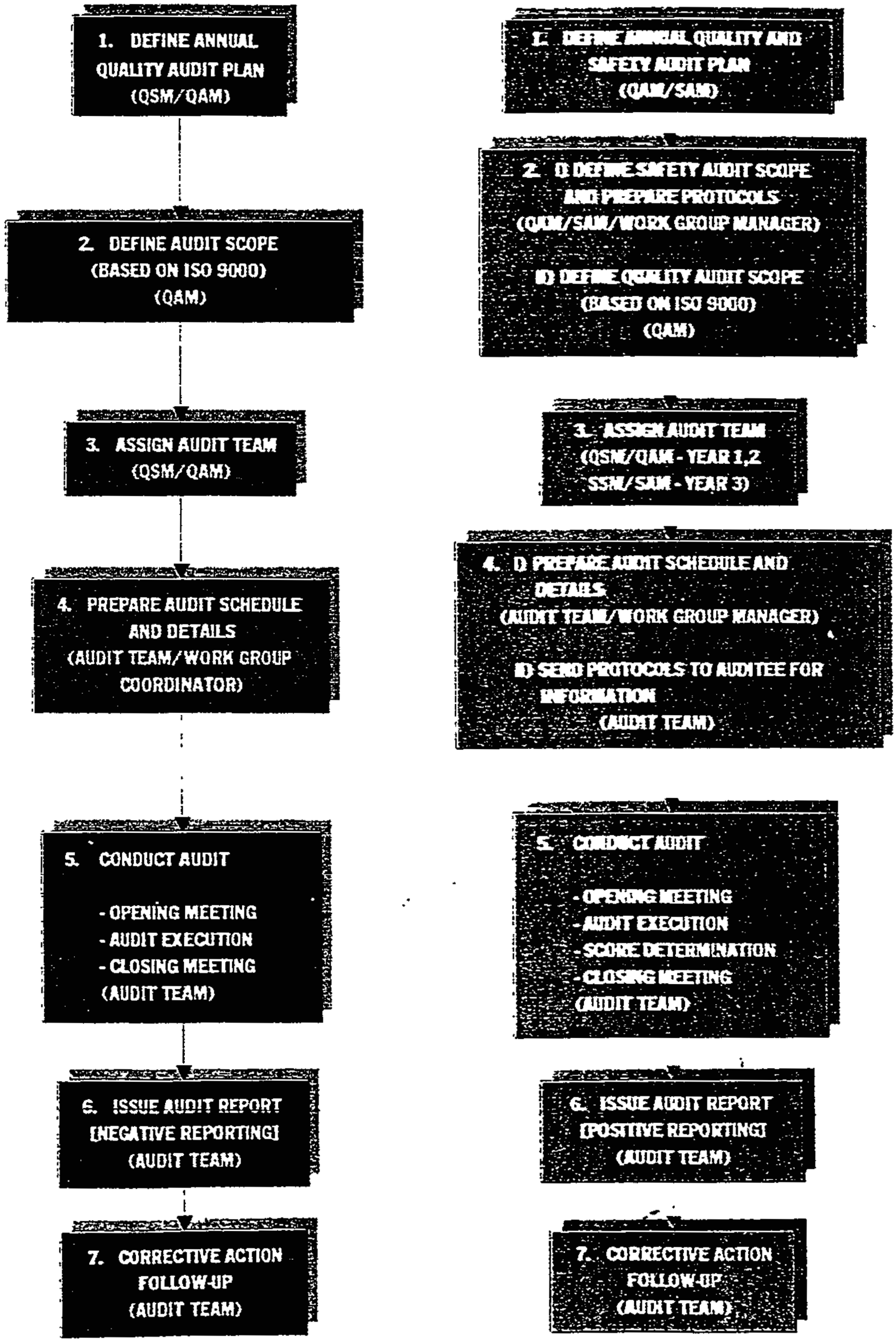
The audit report consists of 5 elements, which are:
I. Summary of Audit;
II. Introduction;
III. Audit Team and Audit Plan;
IV. Audit Finding Matrix,
V. Corrective Action Request.

6. ISSUE AUDIT REPORT [POSITIVE REPORTING] (AUDIT TEAM)

The implementation effectiveness of the corrective actions are verified by the audit team, if effective, the CAR can be closed-out.

7. CORRECTIVE ACTION FOLLOW-UP (AUDIT TEAM)

AUDIT FLOW COMPARISION



QUALITY SYSTEM AUDIT

1. DEFINE ANNUAL QUALITY AUDIT PLAN (QSM/QAM)

2. DEFINE AUDIT SCOPE (BASED ON ISO 9000) (QAM)

3. ASSIGN AUDIT TEAM (QSM/QAM)

4. PREPARE AUDIT SCHEDULE AND DETAILS (AUDIT TEAM/WORK GROUP COORDINATOR)

5. CONDUCT AUDIT
   - OPENING MEETING
   - AUDIT EXECUTION
   - CLOSING MEETING

   (AUDIT TEAM)

6. ISSUE AUDIT REPORT [NEGATIVE REPORTING] (AUDIT TEAM)

7. CORRECTIVE ACTION FOLLOW-UP (AUDIT TEAM)

QUALITY & SAFETY AUDIT

1. DEFINE ANNUAL QUALITY AND SAFETY AUDIT PLAN (QAM/SAM)

2. I) DEFINE SAFETY AUDIT SCOPE AND PREPARE PROTOCOLS (QAM/SAM/WORK GROUP MANAGER)

   II) DEFINE QUALITY AUDIT SCOPE (BASED ON ISO 9000) (QAM)

3. ASSIGN AUDIT TEAM (QSM/QAM - YEAR 1,2 SSM/SAM - YEAR 3)

4. I) PREPARE AUDIT SCHEDULE AND DETAILS (AUDIT TEAM/WORK GROUP MANAGER)

   II) SEND PROTOCOLS TO AUDITEE FOR INFORMATION (AUDIT TEAM)

5. CONDUCT AUDIT
   - OPENING MEETING
   - AUDIT EXECUTION
   - SCORE DETERMINATION
   - CLOSING MEETING

   (AUDIT TEAM)

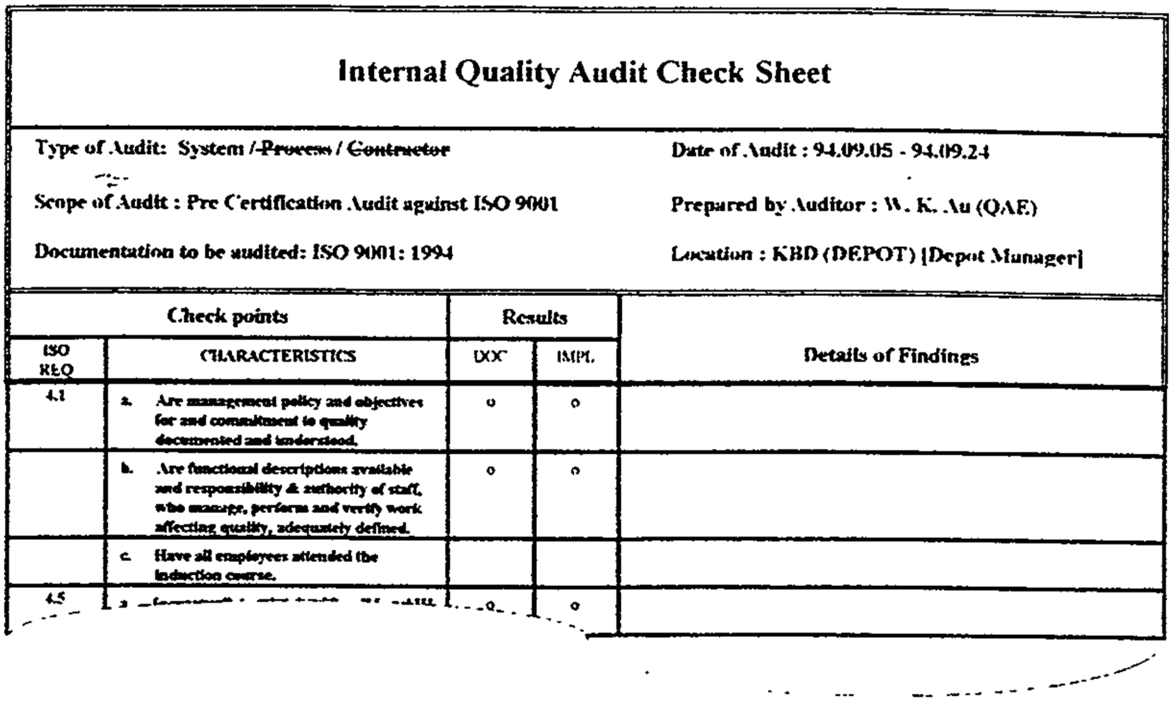
6. ISSUE AUDIT REPORT [POSITIVE REPORTING] (AUDIT TEAM)

7. CORRECTIVE ACTION FOLLOW-UP (AUDIT TEAM)

CHECKLIST COMPARISION

	QUALITY SYSTEM AUDIT CHECKLIST	ADL PROPOSED AUDIT CHECKLIST
INCLUDING STATEMENT TO VERIFY DOCUMENTATION ADEQUACY	✓	✓
	Written as "check point" format in the "RESULTS" column.	Written as question format in the "QUESTION" column.
INCLUDING STATEMENT TO VERIFY IMPLEMENTATION EFFECTIVENESS	✓	✓
	Written as "check point" format in the "RESULTS" column.	Written as question format in the "QUESTION" column.
SPACE FOR EVIDENCE RECORDING IN THE CHECKLIST	✓	✓
	Name as "Details of Finding" column for evidence recording.	Name as "Auditor Comment" column for evidence recording.
SCORING SYSTEM TO RATE THE % OF COMPLIANCE	✖	✓
	N/A for system audit, no partial credit is given for each check point.	% of compliance is used, and partial credit can be given and recorded in the "Part" column.
"NOTES TO AUDITOR" COLUMN	✖	✓
	All questions are considered as reminder and notes to auditor.	"Notes to Auditor" column for reminding purpose, and serve a purpose to provide special information to auditor.

Sample of the Internal Quality Check Sheet



Internal Quality Audit Check Sheet

Type of Audit: System / ~~Process~~ / ~~Contractor~~

Date of Audit : 94.09.05 - 94.09.24

Scope of Audit : Pre Certification Audit against ISO 9001

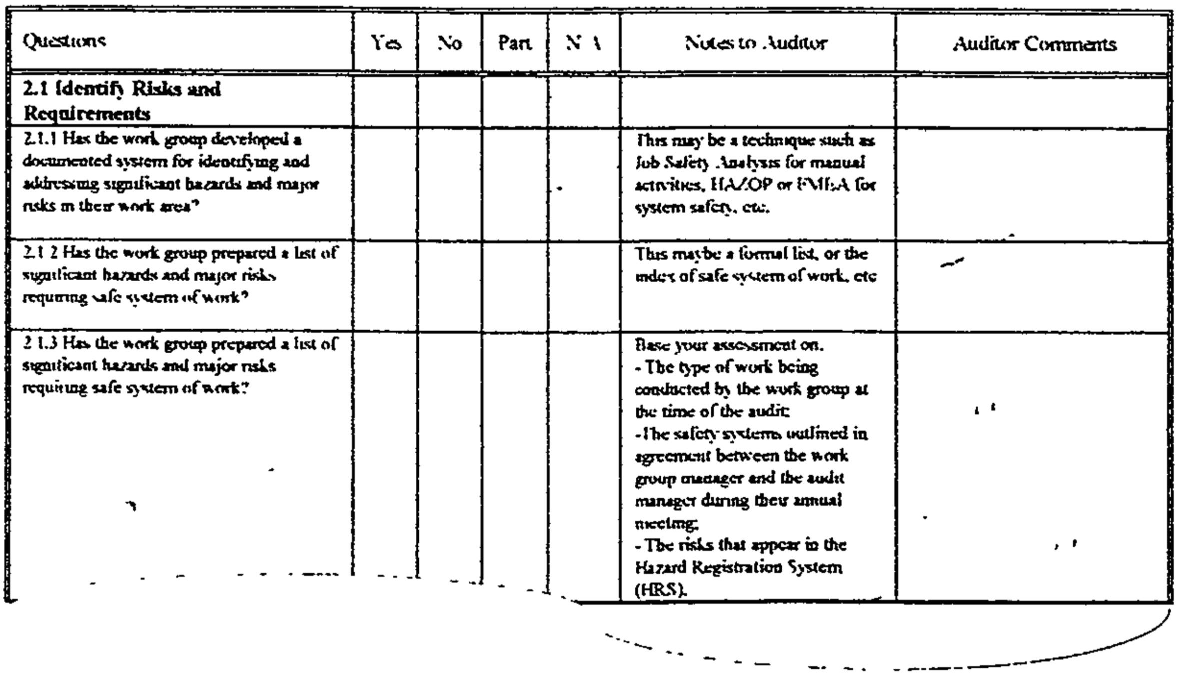
Prepared by Auditor : W. K. Au (QAE)

Documentation to be audited: ISO 9001: 1994

Location : KBD (DEPOT) [Depot Manager]

Check points		Results		
ISO REQ	CHARACTERISTICS	DOC	IMPL	Details of Findings
4.1	a. Are management policy and objectives for and commitment to quality documented and understood.	o	o	
	b. Are functional descriptions available and responsibility & authority of staff, who manage, perform and verify work affecting quality, adequately defined.	o	o	
	c. Have all employees attended the induction course.			
4.5	a. [illegible]	o	o	

Sample of the ADL Proposed Protocol



Questions	Yes	No	Part	N A	Notes to Auditor	Auditor Comments
2.1 Identify Risks and Requirements						
2.1.1 Has the work group developed a documented system for identifying and addressing significant hazards and major risks in their work area?					This may be a technique such as Job Safety Analysis for manual activities, HAZOP or FMEA for system safety, etc.	
2.1 2 Has the work group prepared a list of significant hazards and major risks requiring safe system of work?					This maybe a formal list, or the index of safe system of work, etc	
2 1.3 Has the work group prepared a list of significant hazards and major risks requiring safe system of work?					Base your assessment on. - The type of work being conducted by the work group at the time of the audit: -The safety systems outlined in agreement between the work group manager and the audit manager during their annual meeting; - The risks that appear in the Hazard Registration System (HRS).	

CONCLUSION

BASICALLY, THE

1) PHILOSOPHY,
2) APPROACH,

ARE SIMILAR.

What is the benefit?

- minimise no. of Audit and to reduce disturbance
- more efficiency (overlap requirement)
- consistent approach to audits

International Rail
Safety Conference

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Paper 9519

Dieter Metz

Update on the operational supervising System in DB AG

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IV/2 Dieter Metz

Update on the operational supervising System in DB AG

Update on the Operational Supervising System in DB AG

D. Metz DB AG

1. Present Situation

For ensuring a safety organization which complies with judicial requirements, a railway undertaking has to see to it that the staff working in the Operations Service are supervised adequately.

The DB AG has two supervision levels in the field of operations safety:

- Supervision of operations staff by their direct superiors (direct supervision of safety),
- supervision that the safety supervisors perform their functions adequately.

This supervisory system dates back to the period prior to the merger of the two railways DB and DR and also prior to the structural reform of the railways.

2. Reorganization of the Supervisory System

Therefore, the organization and efficiency of the operational supervisory system had to be examined and reorganized.

The respective reflections are described in the following charts.

First of all, I would like to mention that – apart from the supervisory system – the functioning of the operational processes as a whole is regularly examined. For this purpose, safety audits are carried out.

Arthur D. Little has been retained by Deutsche Bahn to study the process for supervising and monitoring operations safety

Goals:

- Development of a legally sound, transparent and economically viable organisational structure and event sequence for the process

Study objectives and scope:

- Stock-take of the current monitoring system, specifically with regard to the current regulations and the new responsibilities of the restructured business areas
- Determination of the competencies that are specific or common to the business areas studied
- Integration of the experience gathered within other safety related areas and foreign railway companies
- Development of recommendations for optimisation of the system

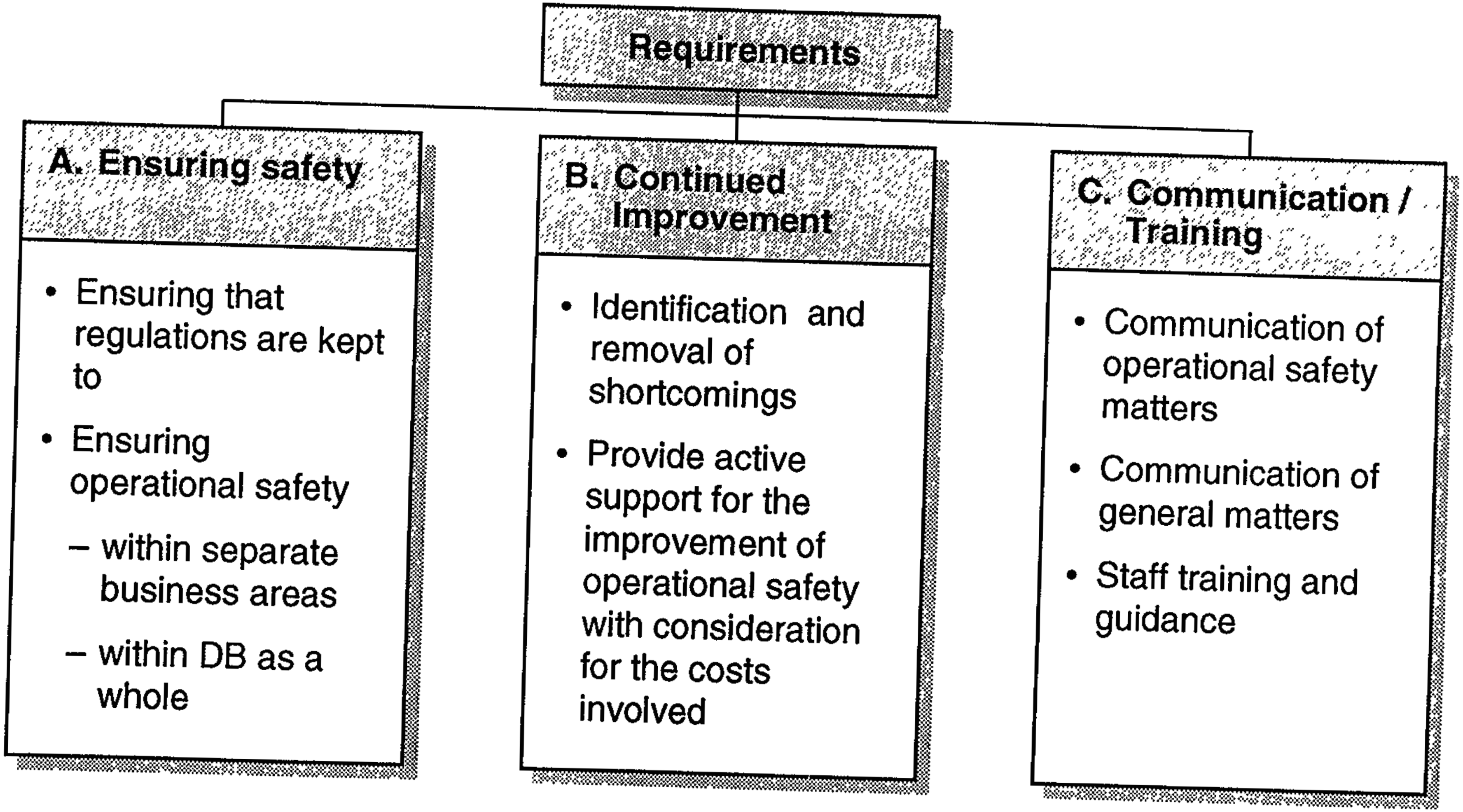
Background

Deutsche Bahn AG (DB) was formed from the former Bundesbahn and Reichsbahn on the 01.01.1994 . This reorganisation brings with it fundamental changes, such as:

Changes within the German railways

- Release from civil service and budgetary legislation
- Integration of the former Bundesbahn and Reichsbahn organisational structure
- Modernisation and extension of the railway service provided
- Separation of the infrastructure (stations, track) and transportation
- Third party access to the railway network
- Regionalisation - transfer of responsibilities to the local states
- Introduction of the "orderer-pays" principles

The following requirements from the process for supervising and monitoring operations safety were identified within the realms of the current and future context



Requirements

A. Ensuring safety

- Ensuring that regulations are kept to
- Ensuring operational safety
  - within separate business areas
  - within DB as a whole

B. Continued Improvement

- Identification and removal of shortcomings
- Provide active support for the improvement of operational safety with consideration for the costs involved

C. Communication / Training

- Communication of operational safety matters
- Communication of general matters
- Staff training and guidance

In addition to these requirements further needs have been identified

Needs from the process for supervising and monitoring operations safety

The process must:

- Cover all identified needs
- Be standardized within all business areas and third parties
- Ensure adequate coordination of the monitoring of operations safety within all business areas and third parties
- Be carried out by staff of appropriate competence
- Be flexible so that a focus for the supervision and monitoring can be set if required
- Ensure resources for time and personnel
- Be clearly documented and communicated
- Guarantee adequate, auditable and legally acceptable proof of conformity to regulations within the area of operations safety at DB

Within the context of these needs, the study has identified a number of strengths within the process for supervising and monitoring operations safety...

Strengths

- There is a high degree of documented supervision and monitoring of the application of regulations, given the limited resources
- The process provides a simple, universal and well understood method for monitoring safety
- The process is understood and accepted by the Eisenbahnbundesamt
- The process has already been applied in similar form by the former Bundesbahn and Reichsbahn

... and also a number of opportunities for improvement

Opportunities for improvement

Instructions:	• There are no clear instructions detailing how to carry out the monitoring process
Planing:	• Rigid requirements with regard to the duration and scheduling of the monitoring process
Roles and Responsibilities:	• Lack of appropriate means with which to fulfil the required responsibilities throughout DB • Lack of understanding amongst staff regarding active participation in the continued improvement of the monitoring process • Lack of motivating incentives
Monitoring and Documentation:	• Lack of uniform documentation of the monitoring process
Competence and Training:	• Lack of competence in carrying out the process in some business areas • Lack of specific training for the process • Insufficient definition of the competencies required by the supervisor
Communication:	• No clear methods with which to guarantee the feedback from the operations level to the management level

The process for supervising and monitoring operations safety is worthy of improvement. The overall responsibility for the process should be given to the business area Netz

Conclusions

1. The current process does not adequately cover the needs of DB, which have arisen from the new organisational structure and the changes in the business environment
2. The process monitors and guides safety at operations level and should therefore not be replaced or removed altogether
3. It is more advantageous to optimise the current process, instead of introducing new safety management processes
4. Appropriate means must be developed to insure the development of a process that is sufficient and applicable across all business areas, whilst taking into consideration the necessary flexibility required by the different business areas
5. The business area Netz is most suited to taking on the overall responsibility for managing the supervision and monitoring of operations safety across all business areas

1. Development of a new four step approach for the management of the process of supervising and monitoring operations safety:
    - The business area Netz sets down ground rules.
    - The business area Netz and other business areas, as well as third parties, interpret these ground rules.
    - The business area Netz approves the proposed changes on behalf of the board of Deutsche Bahn.
    - The business area Netz carries out spot checks to insure correct application of the approved changes.

2. Introduction of increased flexibility in the ground rules and requirements for time schedules and durations of the process activities:

    Prioritisation within a three tier risk category system.

3. Description of the responsibilities of those involved in the process of supervising and monitoring operations safety.

4. Setting of minimum requirements in documentation and feedback.

5. Ensuring self-checking within the business areas and third parties, as well as spot checks carried out by the business area Netz.

6. Development of a training program for supervisors.

7. Transfer of overall responsibility to the business area Netz.

8. Assessment of safety awareness amongst staff.

9. Further development of the process of supervising and monitoring operations safety within the realms of introducing the Safety Case Method into safety management.

10. Replacement of the current all embracing monitoring carried out by the EBA through spot checks, to be carried out by the business are Netz.

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Gerald Churchill

Organisation of Safety in RATP

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V/1 Gerald Churchill

Organisation of Safety in RATP

23/08/1995

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Organisation of Safety in RATP

G. CHURCHILL

Representative of the Director of Electrical Equipment and Systems
Development and Technical Consistency

1. RATP in its environment

1.1.The urban environment

Since 1959, responsibility for organisation of transport in Ile de France has been borne by the « Parisian Transport Syndicate » (STP), a public establishment with an administrative character, with financial independence. STP is chaired by the Prefect of the Ile de France region, and its board of directors is staffed in equal numbers by state an Region representatives.

STP's field of action covers notably operational choices, pricing and levels of subsidy.

Two major companies share more than 90% of the region's traffic, i.e. 3.2 billion journeys per year for a served population of 10.7 million inhabitants: RATP and SNCF.

- RATP, a public establishment with an industrial and commercial character, accounts for 75% of all journeys made using public transport, i.e. 2.4 billion per year.

RATP operates 4 major networks:

- the Paris metro system (200 km, 15 lines, 372 stations), plus the automatic Orly-Val line,
- part of the RER system (115 km, 2 lines, 66 stations),
- the Paris bus network and part of the suburban network (2870 km, 276 lines, 7300 stops),
- the tramway system (9 km, 1 line).

- SNCF-suburban, which is also a public establishment with an industrial and commercial character, accounts for 17% of journeys, i.e. 550 million per year.

SNCF operates 2 large systems with a total length of 900 km:

- the other part of the RER system,
- the SNCF suburban system.

The remainder of the traffic is accounted for by some one hundred private companies, operating buses in the suburbs.

The remainder of this account is concerned solely with RATP rail system safety organisation, i.e. in the metro system and the part of the RER system operated by it.

1.2.The regulatory environment

As a consequence of its specific character (rail transport), the associated risks and the high degree of integration in the urban environment, the safety of the RATP system is controlled by3 ministries: Transport, Interior, and Industry.

1.2.1 The Ministry of Transport

The Ministry of Transport is the competent supervisory authority in the transport field. The department of land transport in the Ministry of Transport draws up the main texts (laws and decrees) relating to rail transport safety. Authorisation of entry into service for new systems until five years ago used to require the signature of the minister.

In reality, the land transport department has always relied on the operator (RATP, SNCF) to assure and maintain transport safety. Primary liability in the event of an accident has always lain with the operator. However, this situation is not compatible with developments in European regulations. Texts on guided transport safety, the main ones of which date from 1942, are thus currently being recast.

1.2.2 The Ministry of the Interior (home affairs)

The Ministry of the Interior intervenes in several respects.

In the transport part, the « Regional Department for Civil Equipment » in Ile de France authorises entry into service of traditional systems (those which did not require the signature of the Minister of Transport), and controls operation and maintenance of systems in service.

The new texts tend to reinforce the power of the Prefect of the region, by transferring to him a large proportion of the responsibilities of the land transport department, and notably the signature for all authorisations for entry into service.

In respect of that part covering places known as "establishments open to members of the public", i.e. stations, the regulations are much more detailed. Opening authorisations are issued by the « Paris police Prefecture » after consultation with a regional committee for civil defense, safety and accessibility. They also require the authorisation of the Paris fire fighters' brigade.

1.2.3 The Ministry of Industry

The Ministry of Industry intervenes in relation to installations exposed to risk (excluding transport) known as classified installations. It is also the only authority authorised in terms of these regional departments (DRIRE) to exercise certain controls, for example of simple pressure tanks.

1.3 Internal company organisation

The organisation has undergone fundamental reorganisation several times since 1990. The aim of these was, under a policy orientated towards the clientele, to give greater responsibility to operators, to eliminate the excessive number of hierarchical levels, and to contractualise the goals of the managerial personnel.

Outside the financial and human resource management sectors, there are essentially two areas of activity: the passenger service (SV) area, and the maintenance, works and industrial policy (MTPI) area.

1.3.1 The passenger service area

This includes operation of the 3 systems, metro, RER and bus, and also commercial management.

This area employs approximately 24,000 persons, mainly drivers (metro, bus and RER) and station agents.

Each railway line is constituted as an operational unit with, at its head, a line director.

1.3.2 The maintenance, works and industrial policy area

This area combines all engineering, works and maintenance activities. It comprises 7 departments:

- rolling stock in the rail system (metro, RER),
- bus rolling stock,
- electrical equipment and systems (signalling, operating methods, energy supply and distribution, escalators, drainage and ventilation, etc.),
- infrastructures and developments (civil engineering, track, tunnels, buildings, etc.),
- information and telecommunications systems (telephony, office systems, tollbooths and money technology, etc.),
- purchases and supplies,
- major project development engineering assistance.

This area employs approximately 11,000 persons, most of whom are workers.

2 Company organisation in relation to assurance of rail safety

Rail safety is the very top priority of RATP. It is the subject of a company policy and led to a discussion in the board of directors on 29 October 1993. The aim of the remainder of this account is to sketch the main organisational principles of it, and illustrate them concretely.

2.1 The organisational principles

In the rail field, the time factor is a major criterion. Risks of accidents are greater the smaller the time available to assess a situation, take a decision, act and, above all, control action.

The result is 3 major fields of activity, which are, in order of increasing risk:

- **anticipation**, which relates to engineering, and which is characterised by work in teams of specialists who are able to devote the necessary time to devising doctrines, analysing consequences of decisions, implementing them and controlling them before entry into service.

Safety in this area relies on the application of design rules and methods, realisation and control and above all independence of the teams with the responsibility for the successive tasks.

- **deferral**, which relates to repairs and servicing, and which is characterised by its work in teams of specialised operators with sufficient intervention time to guarantee the quality and control of these interventions. Safety here relies on respect for intervention and control procedures, and above all on independence of the control.

- **instant action**, which relates to operation and trouble shooting on the line, and which is characterised by work, often solitary, of operators who must diagnose, decide and act in real time in the event of an operational anomaly. Safety relies here mainly on perfect knowledge and on scrupulous respect of satisfactory regulations, and above all on intense practical training.

2.1.1 Field of anticipation

Engineering is spread throughout the company

In the case of the SV area, there is an engineering entity, placed under the authority of the general management, with responsibility for defining the functional specifications of equipment and rolling stock, and also the installation operational programmes. It guarantees that functional specifications are consistent. It also defines the principles of the rail operation regulations, and instructions are drawn up by the training centre.

Most of the engineering teams are found in the MTPI area. Each department has its own specialist engineering section. The latter define the technical schedules of specification for the invitations to tender and the safety constraints. They monitor design, realisation and installation of systems and equipment. They define the controls to be made, and participate in the controls and acceptance of prototypes and first models in series. They also define the maintenance principles, procedures and operational methods of which are devised by specialised groups.

A system engineering section attached to the equipment and electrical systems department ensures that there is technical consistency.

In the case of the transport's specific safety equipment and installations, internal approval is obligatory before entry into service. It is given by independent teams and relates:

- to signalling diagrams,
- to vital software,
- to vital equipment.

Under European regulations and in connection with the setting up of notified bodies, this approval activity will change, since certification of "generic" safety equipment must be given by independent laboratories. But European regulations do not release operators from their liabilities in the event of an accident. RATP will thus retain internal qualification structures in order to check that the incorporation of certified products does not cause the overall level of safety of the transport system to regress.

2.1.2 Field of deferral

In the case of rolling stock and fixed facilities, maintenance is organised on 3 levels:

- level 1 consists of standard on-line exchange of a removable item of equipment, and is similar to the field of instantaneous action,
- level 2 is carried out in a specialised workshop and consists in restoring the equipment removed at level 1 through a standard exchange of the defective sub-unit (for example, an electronic card). In the case of rolling stock, preventive maintenance operations and cyclical safety inspections are undertaken at level 2,
- level 3 consists in repairing the sub-unit removed at level 2 (for example, an electronic component).

In the case of infrastructures and track, apart from programmed servicing operations, constructions are subject to periodic supervision (auscultation of tunnels and viaducts, walks along the track), and ad hoc repairs (injection, reinforcement of piers, extraction of supports and plates, grinding, tamping, etc.).

2.1.3 Field of instant action

This field relates to several categories of personnel:

- drivers, who are most often responsible for reporting signalling failures, and take the first protective measures in the event of an accident,
- points operators, who are responsible for controlling routes and track machinery,
- regulation heads, who control the line from the centralised control room. Regulation heads act as incident heads by coordinating actions of agents on the line.
- 1st level maintenance teams who carry out emergency interventions in the event of poor operation of installations. The sub-systems concerned are the rolling stock which is repaired if it is possible to return it to an inspection pit at one end of the line, track, which is clouted in the event of a rail breakage, before being repaired during the night (temporary speed limitation is then set up), and signalling.

2.2 Operational safety

The organisational principles have been described above. Practical organisation depends on the system, but in all cases responsibility lies with the supervisory and command agents, and they are given precise tasks relating to regulation control and training.

2.2.1 Operational control

Real time control is ensured by operating and regulatory personnel. Every incident is noted on the driving bulletin and every serious incident is covered by a report (delay, power cut, safety fault, etc.).

All trains are fitted with recording tapes. They are checked each day and complete the real time control. They enable excess speeds, overridings of signal at danger and breakdown of safety devices to be detected. Future trains are planned to be equipped with magnetic recorders.

Every serious incident, or incident the consequences of which could have been serious, leads to an in-depth enquiry, if necessary an inter-departmental one. It is the responsibility of the line director and enables responsibilities to be apportioned, proposals for modifications of regulations to be made, and also modifications for the conversion of installations and for personnel training.

In addition to investigations, there are two complementary and systematic levels of analysis:

- a committee for examining incidents meets each week, in the case of the metro, to analyse incidents, determine their causes and decide on the means to be used to reduce their frequency,

- a two-monthly (metro) or quarterly (RER) conference which analyses a selection of noteworthy incidents, or incidents which have been occurring with preoccupying frequency.

Lastly, at the level of each network, there is a transport inspectorate which ensures that safety indicators, such as signal at danger overridings, excess speeds or dragged passengers, are monitored, and which carries out audits relating to a particular theme (respect of a procedure, maintenance of regulatory texts, follow-through of an investigation).

2.2.2 Training for operational professions

Drivers are trained in alternating fashion. In-depth training is given when they are hired and is sanctioned by several examinations covering knowledge of rolling stock, resolution of equipment failures, regulations concerning signalling, and driving of trains on line with passengers. Examinations take place in the presence of union observers. They may drive by delegation of the supervisory authority on issue of the driving permit. Any safety fault during an examination leads to the candidate being failed.

All drivers have, during their period of service, a time reserved for continuous training, for the purpose of maintaining their level of knowledge.

Supervisory and command personnel undergo training of the same kind adapted for their levels of responsibility. It should be noted that RATP does not yet have true driving simulators for driver training, but that it has simulators for regulation heads.

2.3 Rolling stock and equipment safety

2.3.1 Design and realisation field

For design of a safety system or item of equipment, RATP has set itself 2 principles: to maintain standards previously set and to adapt itself to technical progress.

Starting from the observation that although safety has no price, it has a high cost, RATP adopts and defends the goal of "doing at least as well as at present", since guaranteeing this goal whilst taking account, naturally, of feedback from experience leads to a reasonable level of progress without peaking in comparison to a reference previously recognised as satisfactory.

RATP favours traditional methods of design and demonstration, and standard "rail safety" practice. However, it does not ignore technical progress and the development of different approaches and methods, which are also efficient, in the fields of avionics, space technology and the nuclear field, if the latter may be implemented at a reasonable cost.

RATP was thus the first network to use in an important application (speed control of line A of the RER, SACEM) a microprocessor in an architecture based on the encoding of information and implementing safety applications.

2.3.2 Maintenance field

Rail is characterised by long lifetime facilities. A system such as that of the RATP must thus master simultaneously methods of design and realisation of great diversity and covering several technological generations. One of the company's strategic aims is thus to perpetuate the enormous capital of experience and expertise represented by maintenance.

To this end, a number of actions have been launched. Among others, one could mention:

- dust removal, monitoring and control of procedures,
- mastery of diagnostics and control facilities (automatic testers, auscultation by
- ultrasound of mechanical parts, measurement and control of track geometry by laser beam),
- putting maintenance centres under a quality insurance regime.

2.3.3 Inspections and technical audit

As with operation, at the level of each department there is an « dependability » with responsibility for ensuring that procedures and standard practice are respected, in each discipline.

In addition, in the case of the MTPI area, there is an "dependability" audit (cf. presentation made to IRSS 1993 in Angers), attached to the general management and responsible for undertaking audits in depth, notably in order to respond to the concern evoked previously concerning the major role of maintenance in maintaining rail safety.

2.4 Transverse aspects

Some transverse aspects with an impact on rail safety deserve to be mentioned.

2.4.1 The « dependability » network

The RATP « dependability » network is transverse in the SV and MTPI areas. It was created to meet the need for corporate consistency in the operational safety field, and notably that of rail safety.

Its main missions are:

- to federate « dependability » in the company, notably by publishing methodological guides, thus avoiding divergent or inconsistent approaches,

- to share feedback from experience, and notably maintaining up to date a catalogue of the company's databases,

- organising contacts with the outside (congresses, companies, associations), in order to distribute external experience within departments, and exercise technical supervision.

2.4.2 The return on experience mission

The return on experience mission, which was created in 1995, following the example of what was done in SNCF, is attached to the general management and comprises 4 persons: 1 operator, 2 engineers (1 primarily concerned with systems, the other primarily concerned with mechanics) and 1 doctor. The role of this mission is to analyse the profound causes of certain accidents in a context outside that of the investigation, and stressing above all the human factor.

The mission works on the basis of local analysis forms which use a common basis completed by specific aspects intrinsic to the department.

2.4.3 Occupational medicine

This plays a major role in the prevention of accidents through the exercise of responsibilities in 3 fields:

- recruitment, by carrying out a medical inspection appropriate for the future employment, on all candidates,

- medical supervision, by carrying out a "safety" medical inspection on all agents in safety positions (every 5 years until the age of 45, and every 2.5 years over 45),

- employment conditions, issuing an opinion on changes in work positions, particularly in relation to ergonomics.

2.4.4 Legal responsibilities

The French criminal code changed in 1993, and notably introduced the notion of a risk offence, instituting criminal liability of legal entities. Changes in case law, both for company agents, and for the company itself, must be monitored in order that we may react as quickly as possible, if necessary. This supervisory role is undertaken by the RATP legal department, which appointed a representative in the operational safety network in order that operators, engineers and maintenance personnel could incorporate this often neglected dimension of rail safety.

2.4.5 Crisis management

In the event of a casualty or rail accident, RATP has:

- an RATP emergency command plan, which defines on the one hand the procedures for command, intervention and coordination between the RATP managers and the emergency fire-fighters director responsible for directing all public emergency services and, in addition, relations with the press and the organisation of victims' families' reception.

- a crisis communication plan which specifies the arrangements to be made in order to ensure:

  - reception and information of victims' families and the public,
  - good relations with the media,
  - consistency of the messages exchanged with the various competent
  - governmental and administrative bodies,
  - information within the company.

- a centralised crisis station with the information and communication logistics resources.

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Application of Computer Support to the Management of Emergencies

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Application of Computer Support to the Management of Emergencies

Application of computer support to the management of emergencies

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Abstract

Modern mass transit railways are becoming increasingly complex, involving more and more computer-controlled equipment and sophisticated software in an attempt to carry more passengers, reduce operating cost and enhance customer service. In order to maintain a safe and efficient service, an operator at the central or station level is expected to be able to react to any incident or deviation from the norm correctly and promptly. This paper highlights the need to provide more active support to the management of system emergencies, focusing on how the technologies of expert systems and formal methods could be utilised in this area.

1 Introduction

An emergency on a mass transit railway can be defined as any incident which could give rise to casualties to passengers or staff, damage to equipment/environment, or major interruption of services, which may lead to an unacceptable increase in societal risk. Since the management of emergencies is crucial to the successful and safe operation of a railway, tools should be provided to improve the effectiveness of incident management.

Unfortunately, in spite of the many applications of the computer in the modern railway, relative little attention has been paid to its role in the management of emergencies. In particular, it is not clear what software technologies would be most appropriate in this important area.

This paper is not intended to be a systematic investigation of all the issues associated with emergency-support systems. Rather it is a discussion paper covering the appropriateness of using expert systems and formal methods for emergency management, using the experience of developing a pilot Station Management Expert System at the Hong Kong Mass Transit Railway Corporation [1] as a pivotal reference.

2 Emergency-support systems

The main objectives of an emergency-support system are:

(a) provide timely advice on how to handle an emergency
(b) reduce the workload and stress level of the operator
(c) provide feedback on the effectiveness of measures taken
(d) decrease the probability of human errors in managing complex tasks

Items (a) and (b) have been discussed in [3] and [1] respectively. Item (c) includes real-time feedback, which is essential for determining how an incident has developed. It also includes 'post-event analysis' (e.g. in the form of accurate replay of incidents), which is useful for inquiry purposes, and for making continuous improvement to the way in which incidents are handled.

Trying to decrease the probability of human errors involves the elicitation and representation of knowledge on safety and operation, as well as the presentation of emergency scenarios to the operator, as elaborated below.

2.1 Representation of safety goals

In managing an emergency, an operator, who has in-depth knowledge of the operational environment, would typically follow a procedure/checklist to perform manual actions and automatic control functions on relevant equipment. However, often the goals with regard to safety are not explicitly stated in such procedures because it is assumed that the human operator would have an understanding of the rationale behind the steps involved. If computer support is to be provided, it would be necessary to capture this understanding, as well as general knowledge about the operational environment.

To illustrate how this can be done, consider the problem of evacuating a station. Intuitively, evacuation is taken to mean that passengers follow certain safe routes to get to a safe place at ground level. Yet this is not the only form of evacuation. For instance, if the fire is on the concourse, but not the platform, and it is safe for trains to travel, an effective means of evacuating passengers on platforms is to send empty trains to the station to carry them away (care must be taken to avoid sending trains with passengers to the affected station).

If a station has to be evacuated due to fire or other serious threats, then the high level safety goals, in order of priority, can be formulated as:

(a) minimise passenger and staff casualties
(b) minimise the level of damage
(c) minimise service interruption

There are at least two independent ways of satisfying (a):

(a.1) avoid sending people to the affected areas
(a.2) remove people from affected areas via safe routes

These rules can be refined further by making precise some of the terms used. Thus a 'safe' route is one which is unobstructed, free from smoke and fire, and which leads to a place of ultimate safety.

Goals can also be refined according to the nature of different kinds of scenarios. Thus if the concourse is on fire, (a.1) may be successively refined to arrive at the recommendation that escalators going up to the concourse be stopped or reversed, similarly (a.2) may be refined to arrive at the recommendation that empty trains be deployed.

Safety goal (b) can be refined in a similar way. For instance, to minimise damage caused by a fire, the following actions may be performed:

(b.1) compartmentalise the fire
(b.2) perform pressurisation
(b.3) insulate areas likely to be affected

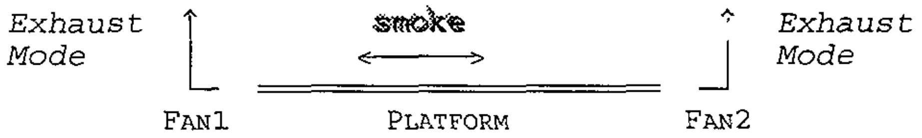
These rules can be refined further: compartmentalising a fire in a plant room would involve closing fire dampers etc.

This example demonstrates that high-level abstract safety goals can be refined, in a stepwise manner, to derive low-level precise control actions that could be executed by a computer. An explicit representation of safety goals forms the basis of action plans. It also serves as a kind of 'filter' to protect the operational environment from any adverse decision made by the operator [5].

2.2 Representation of operational knowledge

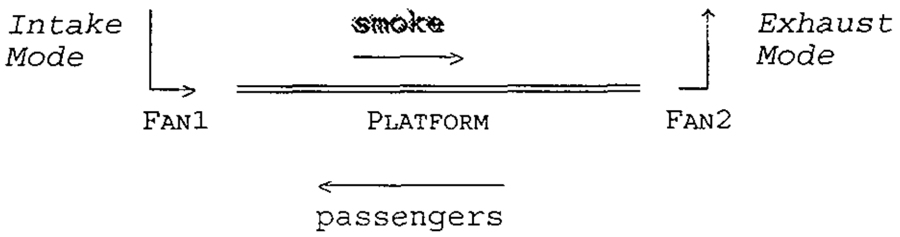
In addition to safety goals, an emergency-support system must also capture and represent specialised operational knowledge.

As an illustration, suppose heavy smoke in the centre of a platform is to be cleared using two emergency fans located one at each end of a platform. In an attempt to drive smoke out of the platform 'as quickly as possible', it may be tempting to operate both fans in *exhaust* mode, as shown below:



This would cause smoke to spread across the length of the platform, and therefore would only work well if the platform is relatively empty of passengers, or during non-traffic hours.

If the platform is crowded, a better option is to extract smoke through one end of the platform, and to direct passengers to evacuate through the other end:



If both ends are safe for evacuation, further considerations should be given to the distribution of passengers throughout the platform, as well as air flow resulting from train movement ("piston effect").

This example shows that a computer system does require a significant amount of information to arrive at a seemingly simple conclusion.

2.3 Presentation of scenarios

One of the most important component of an emergency-support system is the user interface, which deals with the presentation of the real-time status of various devices, the layout of the station, alarms and advice checklists to the operator.

In contrast to Computer-Aided Design applications, the objects on the user interface, such as icons (representing equipment), floor-plan objects, layout, etc. are "active" objects with appropriate attributes (e.g. real-time status). Such objects can be structured in a hierarchical manner. Thus for example, entry gates can be considered as a sub-class of fare collection devices which is in turn a sub-class of general devices. This method of organising data is a key feature of object-oriented programming, a new paradigm for software development. It facilitates the process of reasoning from specific indications and alarms to the more general concept of scenarios.

An incident typically starts with certain alarms in certain warning devices (e.g. activation of smoke detectors). As more and more alarms are generated, the emergency-support system would attempt to identify which scenario best applies to the current situation.

Having identified a scenario, the emergency-support system would then advise the operator of what actions to take. For example, if a train inside a tunnel is on fire, detrainment must be carried out and the following ventilation control exercised.

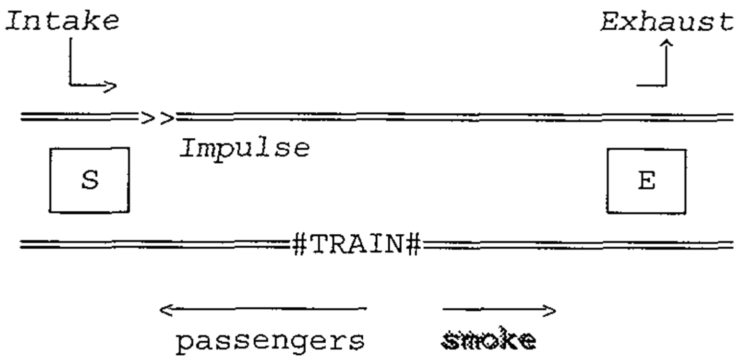
(a) Select station to which detrained passengers are to be directed to (call this "S"). The other station becomes the station to which fire/smoke is to be directed to (call it "E").

(b) Evacuate station E.

(c) All the emergency fans in station S should be switched to intake mode.

(d) The relevant impulse fans in station S should be switched on to direct smoke to station E.

(e) All the emergency fans in station E should be switched to exhaust mode.



By instantiating "S" and "E" with actual station names, the above procedure can be formulated as an action checklist for an operator to follow. Checklists involving multiple parties can also be handled in a similar way, see [3] for further details.

The most significant issue in building a good user interface for emergency management is how to deal with rapidly developing scenarios - how to reason in real time and more importantly how to present the most up-to-date status and advice to the operator.

3 Technologies for implementing emergency-support systems

A number of computer technologies have great potentials for implementing sophisticated emergency-support systems (e.g. mobile computing would allow precise data to be passed between different incident spots in a convenient manner). The focus of this paper is on software technologies, in particular expert systems and formal methods.

3.1 Expert systems

Is the technology of expert systems an appropriate tool for implementing emergency-support systems? Under RIA 23, the standard for safety-related software for signalling [4], the use of artificial intelligence (AI) techniques for software with an integrity level of 3 or 4 is forbidden. There is a strong body of opinion that an expert system is essentially an applied AI system, and as any emergency-support system could be designated at these integrity levels, the answer would appear to be "no".

As shown in the examples given in the last section, the interpretation of various data associated with an emergency situation (which could include heat/smoke detectors, ventilation devices, track circuits, power supply equipment, lifts and escalators, building services and the fare collection system) is a highly specialised task, and hence represents a natural domain for the application of expert systems. For example, in the event of an outbreak of a major fire, many detectors might be activated simultaneously, thereby overloading the operator with detector alarms. He would then have to analyze, filter and interpret all the information available to determine the root cause and take appropriate actions. Such tasks are highly specialised and can only be done well by experienced and qualified staff subject to repeated training.

It would appear that the objection to AI stems from the inability to predict what certain AI systems would do under certain scenarios. However, this need not be the case for expert systems, especially if they are formulated in a declarative manner under the logic programming framework, an explanation of which follows.

Logic programming is concerned with the use of mathematical logic as a programming language: a program is regarded as a set of logical formulae and its execution is regarded as logical inference [2]. Basically this allows the computer to determine "what follows from what". Moreover, it should be possible to identify all the logical consequences which can be derived from the program.

The use of logic as a programming language is not just of academic interest. In fact, many engineering rules and regulations can be formulated in a logic-based framework in a natural way. As an example, to ensure that BTM gas is not discharged inadvertently, each enclosed area with E&M equipment may be divided into one or more BTM protected areas, each of which has at most two Detection Zones. A Cross-Zone Configuration requirement may then be formulated as two logical rules:

(i) A Detection Zone is said to be *alerted* **if** one or more detectors in that zone are activated.

(ii) BTM gas is discharged to a BTM protected area **only if** all the Detection Zones in that area are *alerted*.

It should be clear that this kind of knowledge can be represented much more naturally in a logic programming language than in a conventional programming language such as Basic or C. The main reason is that usually the interpretation of one rule would cause another rule to be invoked ("chaining") and it is tedious to enumerate all the combinations in a conventional program. Furthermore, such rules may be used in a "forward chaining" manner, triggered by the activation of detectors, or in a "backward chaining" manner, where a check on whether BTM gas should be discharged would eventually cause status of relevant detectors to be examined. A further complication is the need to represent **only if** conditions, which do not have any direct counter-part in conventional programming languages.

3.2 Formal methods

A system which provides support to the management of emergencies should be classified as a safety-related system, with an integrity level of 2 or above as defined in RIA 23. Techniques for developing and analysing safety aspects include hazard analysis and formal methods; the emphasis of the former is on the system as a whole, the emphasis of the latter is on the software.

A formal method is one which is based on a formal system like predicate logic (which deals with logical statements involving variables e.g. for all x, x is a train implies that x has doors). Formal methods are typically used at the specification and verification stages of system development. At the specification stage, a formal specification language (such as "Z") is used to specify the requirements of a system. At the verification stage, a formal proof method (such as Hoare's proof using assertions) is used to check that the implemented system exhibit only properties that can be deduced from the formal specification. It is out of the scope of this paper to go into the details of these methods, it suffices to point out that both "Z" and Hoare's method have been used in the development of vital signalling software.

The application of formal methods calls for a rigorous development approach and a high degree of mathematical maturity. It provides further support to the use of logic for programming emergency-support systems, as programs written in conventional programming languages are tedious and too technically involved to specify and verify in a formal setting.

4 Other issues

There is some debate as to whether an emergency-support system should be a decision-support system, under which control actions have to be confirmed by the human operator, or a decision-making system with the highest degree of automation possible. A compromise is to structure control functions in terms of "macro actions": the system would ask the operator whether to proceed with a macro control function, a serious of "atomic" control functions would then be triggered automatically upon confirmation from the operator. Alternatively, if the operator failed to take actions within a pre-determined period of time, the system could perform the actions automatically.

Another challenging problem worth perusing is resource contention. In handling an incident, there may be contention for material or even human resources e.g. if all the rooms with E&M equipment are on fire and there is only limited supply of BTM gas in a central plant room, which room should be handled first? What if the two affected areas call for the same emergency fan to be operated in different modes? Clearly each affected area has to be assessed against other affected areas to determine the priority levels.

5 Conclusion

Providing support to the management of emergencies is a knowledge-intensive task and the technology of expert systems plays a useful role in this area, especially if a logic programming framework is adopted. Logic programming also facilitates the use of formal methods because both are based on mathematical logic.

It is important to note that the use of expert systems and formal methods for emergency-support systems do not preclude the use of other tools and techniques. In particular, extensive testing, simulations, and real-world trials should be conducted to check the effectiveness of an emergency-support system. In addition, independent verification and validation by a qualified third party should also be performed.

Acknowledgements

We thank the Hong Kong Mass Transit Railway Corporation for permission to publish this work. The views expressed here do not necessarily represent those of the Corporation.

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Takumi Takeuchi

Union and Management should work together for Railway Safety

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V/3 Takumi Takeuchi

Union and Management should work together for Railway Safety

INTERNATIONAL RAILWAY SAFETY SEMINER 9 – 11 OCTOBER 1995, MAINZ

Union and management should work together for railway safety

By
TAKUMI TAKEUCHI
EAST JAPAN RAILWAY WORKERS' UNION

1, Before the privatisation of JNR, most unions had believed that "Only the management should manage railway safety and the union need not get involved. When accidents or other problems occur the union should blame the management." Although the Japanese national railways disappeared in 1987 due to privatisation still one of the unions called it "National Railway Workers' Union (KOKURO)" anachronistically. They have not abandoned this idea.

East Japan Railway Workers' Union (JREU), however, does not take this stand. We confirm that railway safety is achieved only when labour and management recognise that railway safety is common to both sides. We should cooperate with each other over the issue regardless of each position.

Safety is the most important issue for the transport industry. When transport workers are on duty, they have to shoulder the crucial responsibilities for the passengers' lives as well as the managers. Also, workers' alertness protects workers themselves from accidents.

For instance, if a train driver has a collision he is likely to be killed, or if a maintenance worker has an accident in rail tracks he is also likely to be killed. We, therefore, have to consider safety issues are also our members concern.

However, safety will never be achieved through enacting rules and manuals because the workers sometimes cannot follow them due to their particular conditions or circumstances. A vital point to establish the safety depends on whether each worker is willing to tackle safety as his own matter aiming to stop accidents and improve safety.

It is also important that the management should not dictate to workers to keep rules and manuals one–sided but they should share the stance of workers who seek safety in their daily work. Since it is human nature to make mistakes, we take it for granted that preventive facilities, equipment or systems that compensate for human errors should be introduced. Furthermore, we can never discuss safety issues without considering workers' *consciousness engaged in their daily work. It is essential that both labour and management should discuss safety issues seriously. When they agree, they should carry out the necessary measures immediately in cooperation.*

2, Now, I would like to show you an example case that safety cannot be realised by enacting rules and manuals, and then I will explain how our union tackled the case.

In the area operated by the JR East Railway, regrettably, accidents where maintenance or electricty workers are hit by moving trains have continued to occur. The death toll of East Japan Railway employees is as followings:

1987 – 2, 1988 – 0, 1989 – 2, 1990 – 1, 1991 – 1, 1992 – 1,
1993 – 2, 1994 – 0, Jan.–Jul.1995 – 1, total – 10

Apart from the above figuars, 21 maintenace workers of sub–contracted companies were hit and killed by moving trains from 1987 to July 1995. Despite the fact that detailed manuals had been followed, these accidents occurred.

In order to prevent further accidents the management replaced the old manual with new one. The main point of the new one was that when maintenance workers worked on rail tracks they must arrange lookout men or place warning equipment, So, they could be aware of an approaching train. However, it was not so easy to put this simple manual into practice. The management at head office announced that maintenance workers must not work without lookout men. They said the workers were allowed to delay the work schedule when they had to arrange for lookout men from their workforce. However, this practice was hardly used.

As a matter of course, a proper number of workers including lookout men should be arranged. However, sometimes, there are some gaps between the management's work plan produced in the office and real work on work–site. The gaps, especially, shortage of workers sometimes results in an increase of workers' workload. These problems should be solved in collective bargaining following the contracted labour and management rule.

We heard reasons from our union members why they could not follow the new manual. We learnt that owing to their working customs being formed and continued over a long period they thought they did not need somewhat troublesome lookout men. Also they preferred to finish their work earlier without lookout men and rest at home. They would not like to arrange lookout men from their limited workforce. This view was shared at the maintenance workplaces.

Recently, one of the maintenance workers was killed by a moving train accident. Although the most up—to—date multiple tie tumper was introduced and the workers did not need to work out from the machine, they still worked on the rail tracks. When he got off the machine to check his completed work, he was hit by the train. In this case, there are some problems of limits of width and definition of the screen displayed by the monitoring TV. However, we believe the main cause of the accident was attitude in the workplace. He and his coworkers were very proud of their craftsmanship. They wanted to do a perfect job and did not like being criticized by anyone else. In order to check his work he got off the machine.

In this case we should not blame only the workers who broke the rules but the management should bear more responsibility than the workers. The managers of his workplace noticed that their men were working on the rail tracks without lookout men and it might lead to an accident. However, they did not point that out because they welcomed efficiency and good result of craftsmanship.

It might be a Japanese a peculiarity but we had to point out that the roots of the problem such as bad working practices and the atmosphere in the workplace encouraged workers to break the rules. In order to solve the problem union leaders brought it to the union members to discuss, cleared the points and decided a policy to overcome the difficulties. Then the union proposed it to the management to seek preventive measures. After labour and management agreed, they both tried to impliment it out thoroughly.

In our experience, after discussions with our union members and frequent negotiations with the management, finally, workers began to follow rules and manuals. This case cannot apply for all. Only when we can find out indirect or hidden factors that might cause accidents and when workers are willing to get rid of them, will safety measures be effective.

3, Now I would like to give you an outline of our union's organisation and movement briefly and then to mention the labour—management relationship of East Japan Railway.

The JREU is an in—house union as well as other trade unions in Japan. In general, union members are all employed by JR East Company. We have four levels in our organisation. They are as follows:

1 Head Office — 9 Regional Head Offices — 85 Branches — 965 Chapters

I will explain about their functions:

a) Head Office ; meets the head office of JR East Company, has collective bargaining, negotiates all kinds of working conditions and concludes labour agreements; talks with the management over business and management plans in the joint management council; and directs its regional head offices and branches.

b) Regional Head Office ; meets the district head office of JR East Company, bargains collectively concerning working conditions in, safety and management issues in each region; talks to the management in the regional joint labour council; and directs its branches and chapters.

c) Branch ; organized in each local area and meets the local business area unit of the company, there is no official negotiation system between labour and management but talks with local area management over safety matters etc.

d) Chapter ; as a rule, organised in each workplace, it does not have the right of official negotiations but discusses safety matters and other subjects with the management in the workplace.

JREU is a single body and each organization has an executive committee. They carry out the same policy. Chapters are the most important basic units for our organization and movement because we find out all problems that the union should deal with, for example, working conditions, safety matters. The chapter holds meetings in the workplace to discuss the theme to be focused. Most of them hold a regular gathering once a month.

Next, I would like to mention the labour–management relationship of East Japan Railway. The union, of course, differs in purpose and priority from the management. I do not think the union always opposes policies proposed by the management but the union and management can cooperate with each other on specific subjects.

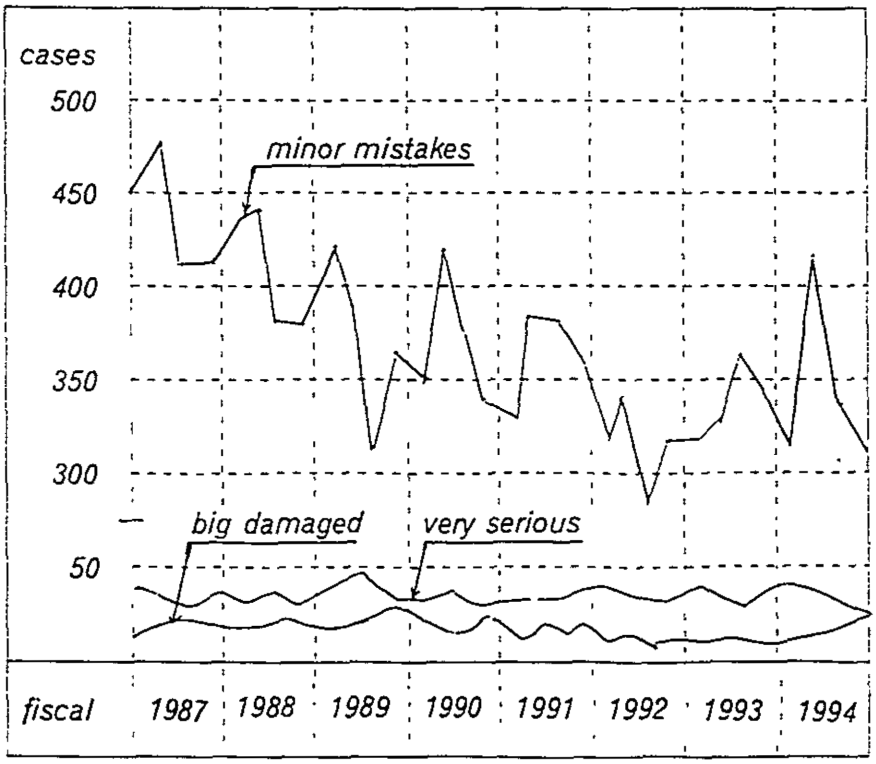
Before privatisation union and management used to conflict violently. At present, however, we changed our stance and create our new union movement: we make claims and demands but also cooperate with the management as the case may be. Both union and management tackle safety issues as a common problem. This is the best example of cooperative relations. We also work seriously and take initiative in the workplace within the limitation of labour agreements. This is our working moral and we have disposed of ideas, such as, "less work and laziness is one of the aims of the union movement," the old union's insistence during the JNR era.

4, New labour–management relationship of East Japan Railway is based on two main communication and negotiation systems, that is, constantly held collective bargaining and joint labour council. Through talks and negotiations we saw our basic salary rise by 40 %, shortened working hours by 10 % for last eight years since privatisation. Moreover, for the same period we also saw railway accidents decrease by 55 % and reduced individuals errs and mistakes by 22 %.

We should alert all accidents. In August 1994, we noticed that minor accidents, most of them caused by human error, were increasing by twice as much as the same period for privious year (1993). They were minor but we sensed they could become serious. If we didn't take any measures, one of these minor accidents would eventually have led to a major accident.

We planned to issue a "safety declaration" to raise the morale of our union members and prevent accidents. The union proposed to the management it should be a joint declaration and we agreed at once. As a result, the joint declaration on railway safety was issued and put it up on the notice boards of all workplaces on 1 December 1994. As soon as the declaration was issued the union members started to discuss safety matters in their gatherings. This declaration was very effective. Following figures proved it:

graph: handling errors & mistakes of JR East emoloyees



After the release of the declaration accidents dramatically decreased by 25 % in the first *quarter of 1995 compared with the third quarter of 1994.*

5, From the view of the union we have to point out the problems concerning railway safety.

At first, the most serious obstacle is bureaucracy growing in the company. Although it has been greatly improved since the privatisation but it occasionaly comes out. For instance, the managers of the head office believe that if they make rules and manuals and inform their employees through the district branches, the employees will firmly keep to them.

Therefore, when accidents or problems occur, at first, head office managers react " It mustn't happen...", " They should have followed the rules." or so forth. Next, they send a notification to keep rules and manuals to the branch managers or try to make another new manual to prevent further accidents. Obviously, they lack in knowledge of real work practice and workplace's mood. They think they have carried out their duties. They have legislated the rules and manuals. If an accident occurs a person who breaks the rule should be blamed for it.

The second obstacle we should remove is bad practices in workplace. It allowed workers to ignore the rules and sometimes fosters excessive pride of craftsmanship. We have to deal with the problem as both sides of coin recognising this custom was formed not only by the management side but also by the union members'. We have to share the resposibility.

We make claims and demands to the management and at the same time struggle ourselves aiming to overcoming these problems. We are also making every effort to improve the safety of the East Japan Railway.

You might think the labour–management relations in Japan as a cosy or "harmonized" one. This is not so in the case of our union. But through cooperation, we will strengthen the relationship between the union and the management.

Hoping more railway <unions and management> in the world will take part in this seminar, I close my presentation. Thank you for your attention.

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Julian Lindfield

Customer Risk Assessment Process

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V/4 Julian Lindfield

LONDON UNDERGROUND LIMITED

CUSTOMER RISK ASSESSMENT PROCESS

PRESENTATION TO INTERNATIONAL RAILWAY

SAFETY CONFERENCE - MAINZ 1995

Designed To

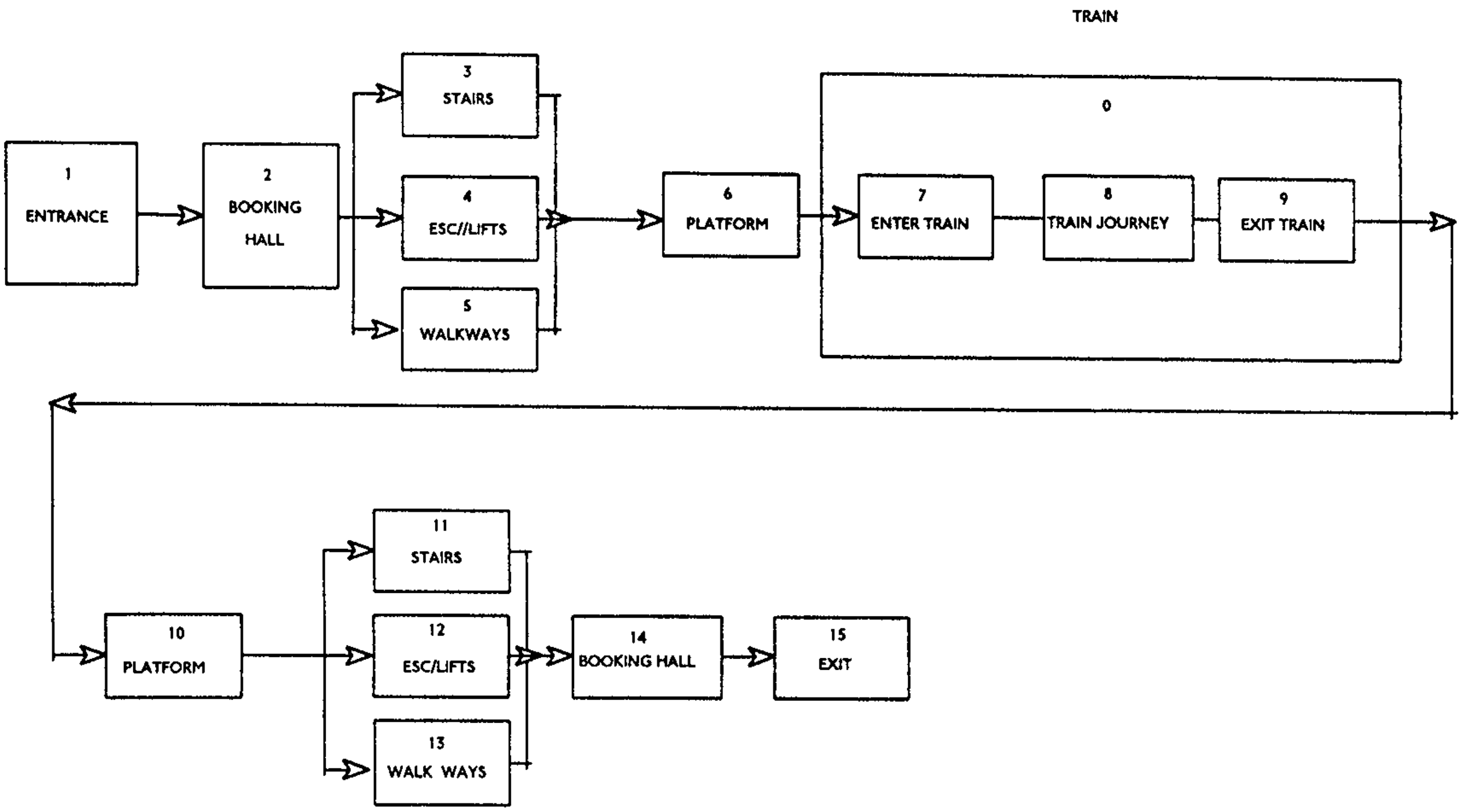
* Use staff and customers to identify risks

* Facilitate Managers understanding of risks and how to prioritise

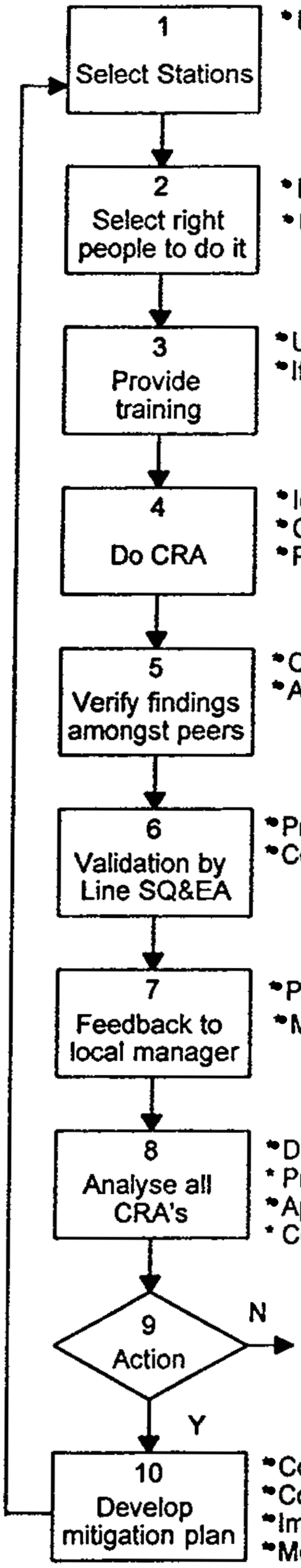
* Compliment process for work place risk assessment
 - 'WRA'

* Facilitate alignment to a change validation process

HAZARDS : CUSTOMER JOURNEY



Method



1
Select Stations

- Either 100% or mixed sample.

2
Select right people to do it

- Preferably small cross-functional team.
- Use local knowledge

3
Provide training

- Use of video and forms + info from Incident Notification Forms (INF)
- If appropriate refer to Line QRA profile and results

4
Do CRA

- Identify hazards from customer point of view.
- Complete form.
- Possibly run customer focus groups or seek customer input

5
Verify findings amongst peers

- Circulate for comments.
- Amend if necessary.

6
Validation by Line SQ&EA

- Provide expert support/comment.
- Collate information for record.

7
Feedback to local manager

- Provide input and agreement (if appropriate) to findings
- Manager to sign off CRA forms

8
Analyse all CRA's

- Determine key messages for Line.
- Prioritise for action.
- Apply the principles of ALARP
- Consider implications to Business Plan.

9
Action

N

File stating reasons for no action

Y

10
Develop mitigation plan

- Consider applying CRACPSCP **
- Consider impact on Safety Case
- Implement; close-out and review progress.
- Measure performance against agreed targets.
- Determine common hazards across all lines.
- Develop mitigation plan for all lines.

** Customer Risk Assessment Change Planning Safety Check Process

Please note:

To compliment this procedure three key documents are attached:

- Appendix 1. A blank pro-forma as a visual aid which can be copied and completed during or after the CRA. This form is on Excel 4 (computer software) and is provided on computer disk if required by Line Managers.
- Appendix 2. This is a completed example of the above form which provided an illustration of possible content.
- Appendix 3. A set of guidance notes and a help sheet on hazards and risks.

In addition a video (as presented to the conference) has been commissioned and produced as a visual aid for communication and training events. It is called Customer Risk Assessment and copies are available from All Unit Safety Quality and Environmental Advisors

CRA Form Definitions:

Location: Is where the CRA is taking place. A brief description ie. sub-surface; open section; busy; interchange; near school or hospital etc. would be useful.

Area: Is linked to the customer journey process map and will be selected as appropriate following sequence of numbers.

Hazard: Is the exposed danger, a condition (eg. damaged step) or practice with potential for loss.

Risk: Is the chance of loss (eg. falling over, trip or slip) from exposure to the hazard.

Who is at most Risk: When evaluating the hazard try to identify those customers most at risk eg. children, OAP's, large parties, mothers with prams, mobility impaired people etc. If other groups are identified to be at risk from the hazard staff, contractors these should also be noted.

Consequences: These are linked to the hazards and are aimed at identifying the most likely outcome and its severity.

Risk Rating - High, Medium or Low: Is determined by factors such as the probability or likelihood of occurrence, possible frequency and the type of injury, loss or damage likely to be incurred.
The decision as to whether the hazard is classified as H/M or L will take into account, things like actuals (based on Incident Notification Data), experience, knowledge and the type of controls in place.

Controls: These are the current prevention activities, systems, procedures, rules and training in place that mitigate the risk. Although these may be many and varied, select those which are considered to be key.

Responsibility for Controls: These are the key functions or groups who are responsible for mitigating the identified hazard.

Suggested Action: These are the opportunities for improvement which could be suggested by the assessment teams; local personnel; staff or through customer input.

Customer Risk Assessment Based on Customer Journey
Example Format and Content

Location	Area	Hazard	Risk	No	Who is most at risk - worst case scenario	Consequences	Risk Rating H/M/L

Customer Risk Assesment based on Customer Journey

Example Format and Content

Hazard No	Controls	Responsibility for	Action Y/N	Suggested Action

Customer Risk Assessment Based on Customer Journey Example Format and Content

Location	Area	Hazard	Risk	No	Who is most at risk - worst case scenario	Consequences	Risk Rating H/M/L
Whitechapel							
Whitechapel is the busiest station on ELL, with 6 platforms and an interchange facility with H & C District	1. Entrance	Damaged step	Falling over	1	Patients of nearby hospital; shoppers; mothers with prams	Bruising; broken limbs	M
	2. Booking hall	UTS gates Queue at booking office	Trapped in gates Pushing	2 3	Children	Bruising to ribs, face, hands, Frustrated customers	L L
	3. Stairs	Slippery stairs	Falling down	4	Elderly	Broken limbs; shock	M
	4. Escalators N/A						
	5. Walkways	Narrow walkways	Collision between customers; pushing; slips; trips	5	Elderly; children; teenagers	Bruising; sprains	M
	6. Platforms	Surface water Poor visibility of exit signs	Slipping Customer confusion and collision	6 7		Bruising; sprains; shock Bruising	M M

Customer Risk Assessment Based on Customer Journey
Example Format and Content

Hazard No	Controls	Responsibility for Controls	Action Y/N	Suggested Action
1.	Handrails; PGI's	Station Staff	Y	Repair damaged steps; provide anti-slip surface
2.	Regular maintenance; rules; staff vigilance	Station staff; 'Westinghouse' (External Supplier)	N	None
3.	CCTV; local procedures	Station Staff	N	None
4.	CCTV; PA; mirrors	Station staff	Y	Provide centre handrail
5.	CCTV; mirrors	Station staff	Y	Consider installing PA; better signage
6	PGI's; maintenance procedures; CCTV; staff vigilance	Station staff; cleaners	Y	Frequency of floor mopping to be increased
7	Station control and evacuation procedures	Station staff	Y	Consider re-positioning of signs

PGI's - Planned General Inspector

CCTV - Closed Circuit Television

PA - Public Address

Customer Risk Assessment Based on Customer Journey
Example Format and Content

Hazard No	Controls	Responsibility for Controls	Action Y/N	Suggested Action
8.	Mirrors; CCTV; PA	Station staff; train operator's	Y	Education campaign; visit local schools; include 'mind the gap' signs on platforms; improve PA announcements
9.	Staff vigilance; passenger emergency handles; staff training	Station staff; train operator's; BTP	Y	Amend rules ie. no alcohol allowed on system; two way communication on trains; CCTV on trains
10.	Mind the gap/step announcements; signs	Station staff; train operators	Y	Greater clarity of roles & responsibilities between platform and train staff

BTP - British Transport Police

CCTV - Closed Circuit Television

PA - Public Address System

Programme for Customer Risk Assessment

Guide-Lines

1. Allow enough time to complete the assessment, remember that conditions on site may vary according to the time of day and the season and this will need to be taken into account.

2. The route for the assessment is station specific and should be as follows
   - enter station [step 1 customer journey process map]
   - purchase ticket [step 2 customer journey process map]
   - proceed to platform [step 3,4,5,6 as appropriate customer journey process map]
   - board train [step 7 customer journey process map]
   - complete journey [step 8 customer journey process map]
   - exit train at same station as journey commenced [step 9 customer journey process map]
   - follow exit route [steps 10,11,12,13,14,15 as appropriate customer journey process map]

Steps 1 to 6 and 10 to 15 are to be assessed by the stations assessor Steps 7 to 9 including the movement from platform to train and from train to platform are to be assessed by the trainside assessor.

3. Involve local staff, use their knowledge of local conditions i.e. type of customer, nearby events, any previous history of near miss type incidents, local pubs or clubs that may pose particular problems. Are there any additional risks caused by weather conditions or that occur because of the time of day.

4. Consider asking customers present during the assessment for their observations.

5. Check local (INF) Incident Notification Forms and accident book [especially useful for determining the frequency and likely harm caused by potential risks. This may help when applying a hazard rating]

6. Try to arrive at a customer profile for each location. Things to consider are: -
   - Is there a school nearby [if so what age group]
   - Is there a hospital nearby
   - Is there a home for the elderly or a day care centre nearby
   - Is there a large superstore nearby [customers may have heavy shopping loads]

Hazards, Risk [Help Sheet]

Hazard	Risk	Type of Injury
Broken step	Falling down	Broken limbs; bruising
Slippery floor surface	Slipping over	Broken limbs; bruising
Narrow passageway	Collision between customers	Bruising
Congestion	Trips & Falls	Broken limbs; bruising
Vomit; Blood; Urine	Coming in contact with contaminated body fluids	Infection, illness
Frayed or damaged electrical cable	Electric shock from contact	Burns or death
Poor lighting	Fall, trip	Bruising, broken limbs
Violent customer	Assault from	Injury
Narrow passageway	Collision between customers	Bruising
Curved platform	trapped in train doors	Bruising; serious injury
gap between platform and train	Fall between	Broken limbs, death

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Francis Callard

Principles of safe movement on Rail: Their Origin and Development in Spoornet - South Africa

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V/5 Francis Q. Callard

Principles of safe Movement on Rail
Their origin and development in Spoornet-South Afrika

INTERNATIONAL SAFETY CONFERENCE

MAINZ, GERMANY 1995

PRINCIPLES OF SAFE MOVEMENT ON RAIL

THEIR ORIGIN AND DEVELOPMENT IN

SPOORNET - SOUTH AFRICA

F. Q. Callard
Senior Manager : Information Systems
Chairman : Safe Rail Management Systems Committee

1. INTRODUCTION

Spoornet is the national railway carrier of South Africa. Operating over 21300 route kilometres, it is primarily a freight transporter which contributes 95% of its turnover. Commercialisation in 1990, resulted in two railway owners of infrastructure and rolling stock. viz. Spoornet and the South African Rail Commuter Corporation (SARCC). The common infrastructure was divided on the basis of whoever was the major user but trains operate across boundaries and into each others territory. Spoornet operates the freight services and the Metro division has responsibility for operating metropolitan commuter transport under contract to the SARCC. The Metro division may yet become a separate entity outside of Spoornet.

Spoornet has changed as an organisation in the technology it uses, the culture of the organisation and in its purpose, as it has changed from a common carrier to a commercial enterprise. The environment has changed in the way it affects Spoornet socially, in business, politically, culturally and statutorily. There is also a general recognition that the organisation's Train Working Rules and Instructions, which have been the mainstay of the organisation's operational procedures since the 1960's, need revision and adaptation to changing circumstances.

This paper describes the principles of safe movement on rail recently developed and the contextual framework within which they were developed. These are a sub-set of the principles of safe rail operations, which with their reference framework, aim to be consistent, coherent and integrated across the scope of the organisation's activities and as all-embracing as possible whilst independent of the specifics of a particular technology or operation. Furthermore the framework and principles are not in themselves a prescription for correct procedures but provide the context of the total set of operations of the organisation and how they interrelate to each other.

The major operational areas of a safe rail management system which are tightly coupled include:

- Movement of rolling stock
- Maintenance of infrastructure
- Hazardous consignments
- Incidents and accidents with and without hazardous commodities
- Employee safety
- 3rd Party interface (e.g. private sidings, rail/road crossings, public safety, etc.)
- Investigative, Legal and Administrative Procedures

It is intended that the safety principles for each operational area are defined in separate documents which in turn are governed by the frame of reference.

2. SAFETY

Safety in Spoornet was historically focused on preventing harm to life and assets and this is reflected in the organisation's current rules and instructions. In line with current trends, we believe that safety should be more inclusive and include the prevention, in a transparent manner, of:

- harm to people, including health of employees and the public
- harm to the assets of Spoornet and third parties
- harm to the environment which includes the natural, working, social, cultural, envioronments etc. and
- harm to the systems of the organisation which enables Spoornet to generate income.

There are any number of definitions of safety but the following was choosen as reflecting the ethos that the organisation wished to achieve.

> "Safety is the responsibility of every employee. It is the desired result of the interaction between components according to prescribed processes which ensures minimal risk of injury to life and damage to property and the environment. These components include:
>
> - the human factor
> - the design of the equipment
> - the designed process and
> - the process actually followed
> - the environment"

It is a prerequisite for safety that all staff are competent to carry out all aspects of their duties.

As part of the interactive process in developing the principles the following safety mission was drafted in conjuction with the trade unions.

> " *A law abiding commercial organisation following safe principles which are:*
> *believed and followed by all employees for the saftey of themselves, their colleagues, clients and society;*
> *for the protection of people, freight, assets and the environment;*
> *and an ethic of responsible behaviour which promotes the well-being of the organisation and its stakeholders.*"

3. THE FRAME OF REFERENCE

The frame of reference provides the paradigm against which the code of conduct containing the principles of safety, guidelines and standards would be measured.

3.1 Objectives and Structure

The objectives of the frame of reference are that they would always strive to promote the concepts of :

- individual accountability and responsibility
- individual ownership of own safety
- individual ownership of organisational safety

This is a cultural shift within the organisation and it has yet to show tangible results.

In line with many other similar documents a three tier approach was adopted which covers principles, guidelines and standards. Each of these are described in more detail.

Principles can be considered the constitution of the organisation. They contain the essential what of safe operations without stating how they should be achieved. They contain accountability and responsibility and if truly universal, should be recognised as such by all operators. They are formulated to recognise the change of states that occur in a process and are independent of time, place and technology.

Guidelines are the how, i.e. the process of fulfilling the principles. They are not in themselves prescriptive but are often written around a specific technology where each technology generally stands alone.

Standards are mandatory in what must or must not be done and are generally specific around a technology. They focus on safe processes and often contain the safe design limits of equipment. When stating what must not be done they prohibit illegal procedures that bypass equipment safety features.

These are to be incorporated in a Code of Conduct which will replace the exisiting Trains Working rules.

3.2 Critical Assumptions.

The assumptions against which the principles and subsequent Code of Conduct would be tested include:

- Spoornet/Metro will remain a commercial enterprise.
- Spoornet/Metro will be law-abiding.
- Safety is not an absolute. Rather it has a price and there are trade-offs in the risks involved.
- Safety will always be subject to the test of the reasonable man.
- Safety will be compulsory and enforceable.
- Employees are cognisant of the cost of safety but Management is the final arbiter of risk.
- Employees act in the best interests of the organisation.

3.3 Benckmarks

The principles, guidelines and standards embodied in the Code of Conduct should be evaluated against the following user and operational benchmarks.

- Flexible in their ease of application
- Unambiguous
- Simple, being easily understood, user and client friendly
- Realistic
- Aligned with statutory requirements; and should:
- Identify responsibility and accountability
- Reflect the man-machine interface
- Ensure and enforce safety
- Ensure handshaking i.e dual commitment by both parties

3.4 Dimensions of competency:

- theoretical qualification (as in examination)
- practical skills assessment
- medical assessment of fitness / physical condition

- self-assessment of physical and mental condition.

4. ORGANISATIONAL CONTEXT

Spoornet's current Train Working Rules date from the mid 1960s when the last major revision took place. The rules and subsequent changes tended to be incident based rather than on statistical analysis or conformance to underlying principles. Whilst basic principles were an underlying tenet of the Train Working rules, they were not explicit and hence not formally verified against a set of principles. It was also an era of steam and electrification and substitution by diesels together with train radio communication, longer and heavier trains, air brakes and the higher speeds they permit have all highlighted the current shortcomings.

On the human side, drivers are undergoing shorter training periods without the lengthy apprenticeship and this gave rise to the concept of the "Golden Rules" of safety.

Spoornet is both the owner of its the infrastructure and the operator of the trains. The SARCC owning its infrastructure and the "ringfencing" of the Metro Division as the operator brings into being the concept of adjoining railways, each with its own infrastructure, where rolling stock and crew traverses each others lines. These common antecedents were the impetus for the development of a common safety case rather than two separate safety cases. In a climate of deregulation it is also possible that other rail operators may wish to use the infrastructure and there are limited mechanisms in place to administer such an eventuality.

Draft statutory regulations on a safe rail management system were published in January 1995 to which Spoornet and all other rail operators will have to comply. The development and application of principles of safety would result in a closer correlation between external statutory requirements and the dynamic internal business forces within the organisation.

In the attached diagrams are depicted the external and internal forces impacting the safe rail management system.

At the same time it was necessary to revisit a number of definitions and a set approach has been followed where ever possible. Two examples are given, one for rolling stock and the other being a new definition for a licence and the procedures to obtain it.

The role of the principles in Spoornet are apparent when considering the diagram, Functional use of Principles. This highlights both their pro-active and reactive use from the development and implementation of new rules, through their auditing to incident investigation and possible judicial inquiry.

5. PRINCIPLES FOR SAFE MOVEMENT ON RAIL

The principles were developed considering the four possible states of stationary, preparing to move, moving and stopping. Principles common to movement, accepting and issuing an authority and personal behaviour were also identified. They are given below.

5.1 Principles Of Movement (Train And Shunting Movements)

the track must be defined	**to move**
the defined track must be clear	
no movement without authorisation	
adhere to speed instructions	**whilst moving**
adhere to trackside and other indicators	
stop at limit of movement	**to stop**
stop when and where scheduled	
must stand clear (not foul)	**whilst stationary**
must be secured (against movement)	
must be protected	
shall have one meaning only	**authority**
shall not allow conflicting (following or opposing) movements	
holds good until executed or surrendered / withdrawn	

5.2 Principles Common to Movement

- rolling stock must be serviceworthy
- the infrastructure must be trainworthy
- authority to be issued and accepted
- know location, extent and limitation
- handshake all authorities
- feasibility of execution
- continual communication

5.3 Principles Common To Personal Behaviour

- be alert, vigilant and assess surroundings
- responsibility cannot be shared
- be fit for duty

5.4 Principles Common To Issuing And Accepting An Authority

- be licensed to perform the task
- have a hierarchy of fall-back procedures
- have a hierarchy of contingency plans

5.5 Verification of the Principles

Each train operating system has been analysed for its compliance or otherwise to the principles and they have been extensively discussed within the organisation . This has led to their refinement whilst hopefully maintaining the balance between their being so sterile as to be meaningless. External comment has also been invited to complete the validation process and is being actively pursued. This is in the belief that if they are truly universal, then they would be applicable to other railways apart from ourselves.

The work to date has been the output of a multi-disciplinary team operating on a part-time basis outside of their normal line function. This has the benefit of a each aspect being looked at from as many angles as possible and the results would have been the poorer for the absence of any discipline.

The next phase is the creation of the task team to revisit the current regulations and rework them where necessary into a Code of Conduct, in compliance with the principles and to aid an understanding of safety based on the "Golden Rules"

6. CONCLUSION

In the brief time available, I have attempted to outline the forces behind the creation of Spoornet's principles for safe movement on rail, the paradigm which they seek to create and enforce and the most importantly the principles themselves. In the belief that they are more universally applicable, we look forward to their verification and translating them into concrete guidelines and standards.

I am grateful to my colleagues and Spoornet for the input they have provided into this paper and the opportunity to present it.

DIAGRAMS :

Diagram 1: External and Internal Forces

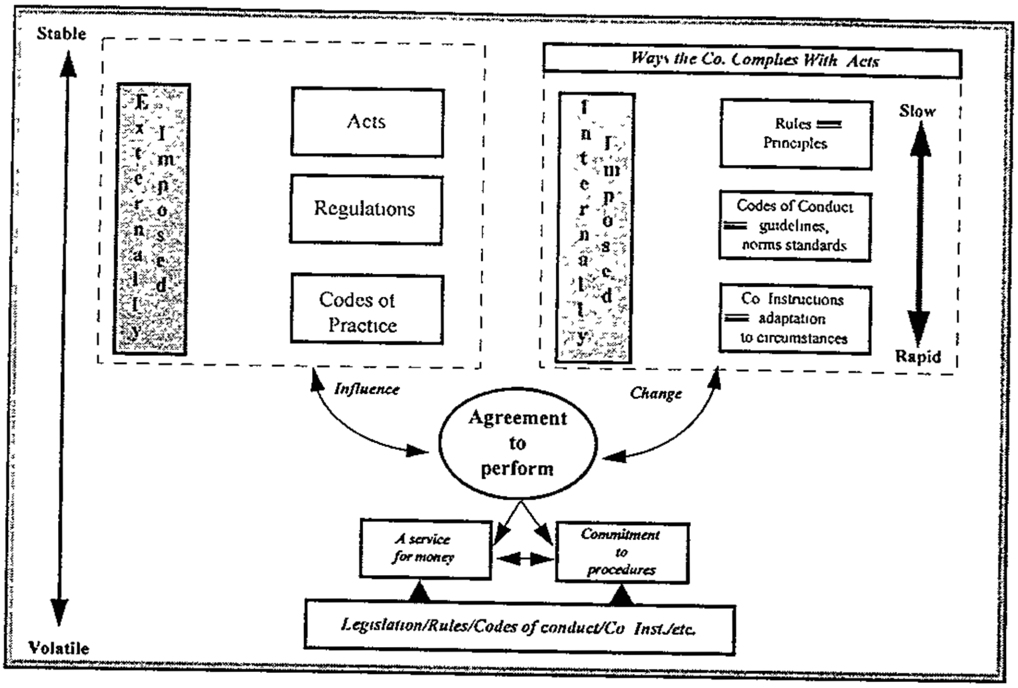
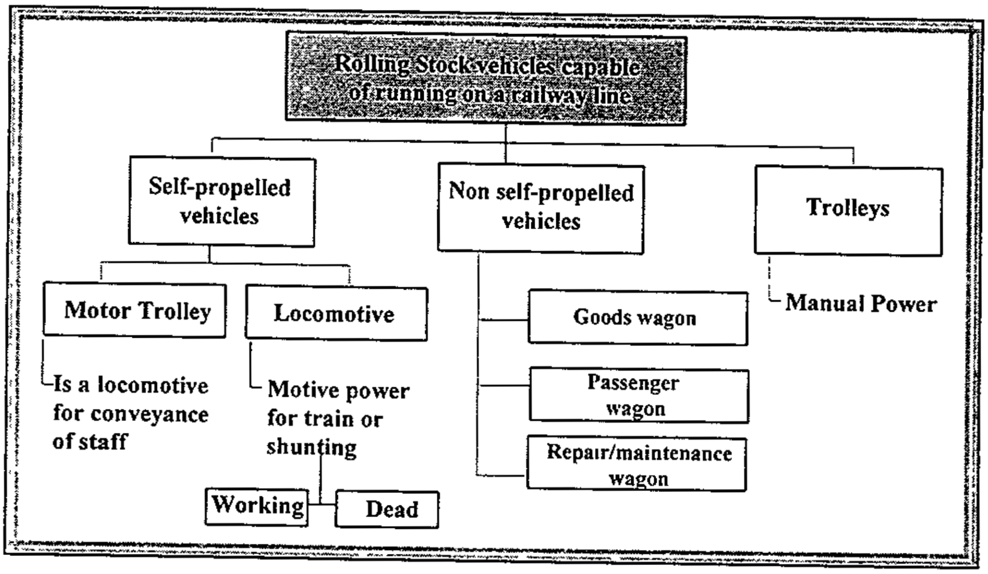


Diagram 2 : Rolling Stock Definitions



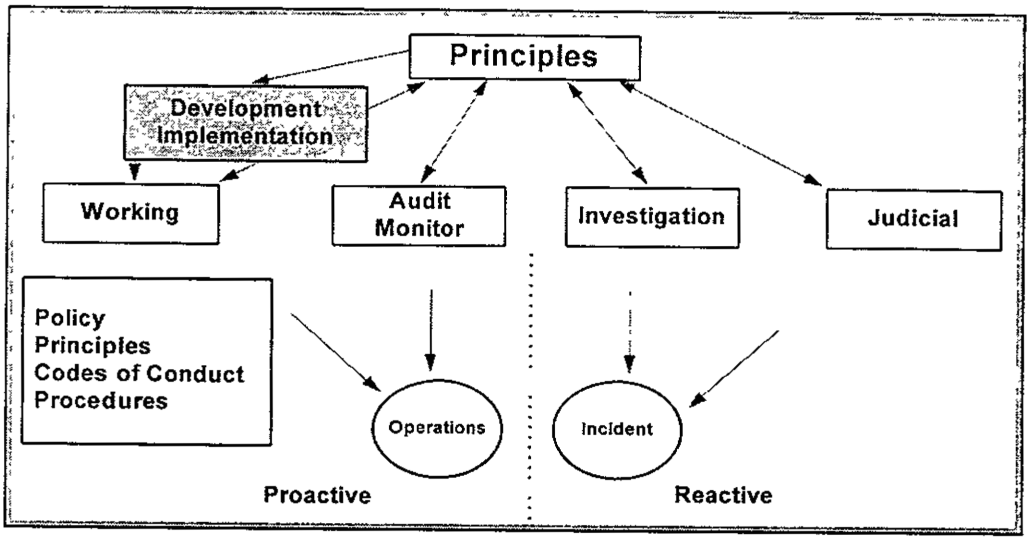


Diagram 3 : Steps to Obtain a Licence

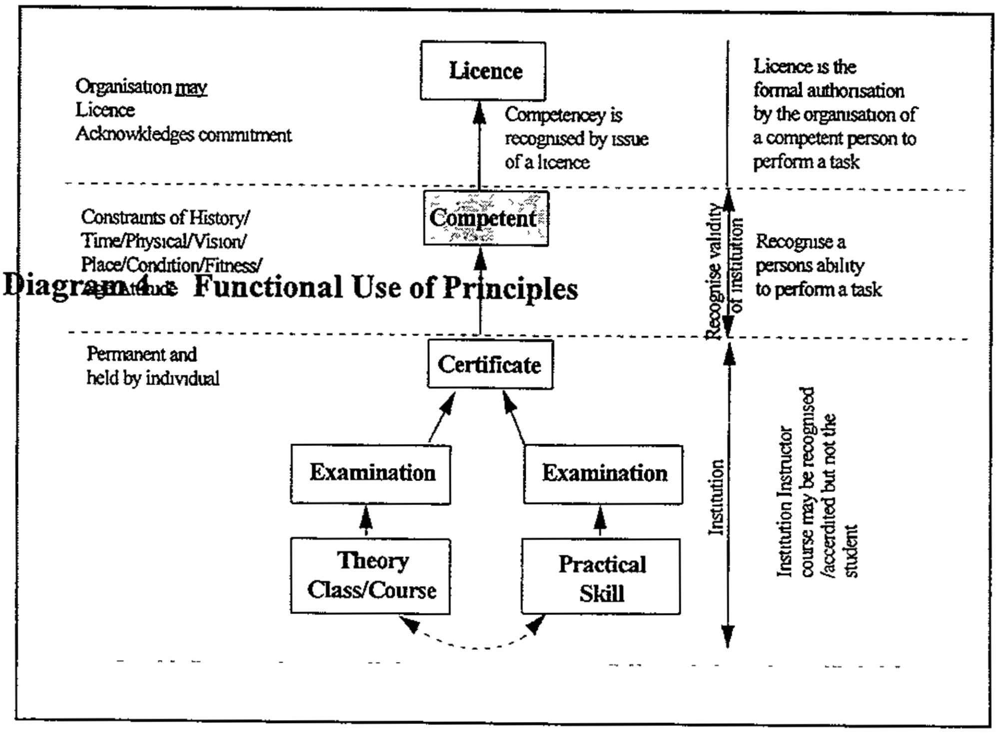


Diagram 4 : Functional Use of Principles

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George Lee

Development of a Contractor Safety Management System in the Mass Transit Railway Corporation

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Development of a Contractor Safety Management System in the Mass Transit Railway Corporation

Development of a Contractor Safety Management System in the Mass Transit Railway Corporation

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Summary: In order to improve the safety performance of contractors working on the Mass Transit Railway, a Contractor Safety Management System is being developed. For every project, the severity of the hazards are analysed and the project is allocated a Safety Classification. Contractors may only tender for the work if they possess a Safety Classification that is equal to or better than the Safety Classification of the project. Tenderers will only be granted a Safety Classification after their Safety performance is evaluated "on the job". Safety control requirements will be written into the contract and will depend on the safety classification of the project. The contractor will be required to develop a safety plan for the project. Inspections and audits will be conducted during the construction phase. The contractor's performance will be reviewed periodically during the project. After the project, the contractor's safety classification will be reviewed, based on its safety performance during the project.

1. Introduction

In 1992, MTRC implemented a Safety Management System which focuses on maintaining a culture of safety awareness and employing management systems to achieve continuous improvement in safety. This contributed to a downward trend in staff accident rate, but did not improve contractor safety performance.

The construction safety performance in Hong Kong is somewhat low, given its state of development. In 1994, there were 53 industrial accidents per 1000 workers in Hong Kong, out of which 0.08 accident was fatal.

Although the safety performance of contractors who worked for the Corporation has been good by Hong Kong standard. In the last few years, there were signs of the beginning of a dip in performance. Management are anxious to turn back this trend. Also, it was noted that, with considerable equipment reaching its mid-life, there will be increasing need for refurbishment and overhaul. In addition, there is a strategy of asset replacement to optimize performance and reliability. An increase in the use of contractors on the operational railway in the next few years is therefore anticipated. Although it is contractors' responsibility to work safely, contractor accidents impact upon railway safety and Corporate image. A decision was therefore made to establish a formal system to manage the safety of contract work. The system is called "Contractor Safety Management System".

2. Scope

Safety performance of contractors can affect railway safety in two ways:

(1) site safety, which is the safety of the activities carried out by a contractor on site:

(2) system safety, which is the life cycle safety of the systems or equipment designed or constructed by a contractor.

While the ultimate Contractor Safety Management System will include both aspects, the initial development, which is the subject of this paper, will focus on site safety only.

3. Strategy

The purpose of the Contractor Safety Management System is to adopt a systematic approach to improve the safety performance of contractors, without reducing their obligation for safety under the contract.

For every project, the severity of the hazards is analysed and the project is allocated a Safety Classification. Contractors may only tender for the work if they possess a Safety Classification that is equal to or better than the Safety Classification of the project. Tenderers will only be granted a Safety Classification after their Safety performance is evaluated "on the job". Safety control requirements will be written into the contract and will depend on the safety classification of the project.

The Contractor Safety Management System will be implemented in two phases:

- Initial phase, starting late 1995. During this phase, tenderers do not possess a safety classification;
- Ultimate phase. During this phase tenderers will already have an appropriate safety classification, as a result of evaluation of their safety capability through analysing their performance in a prior project.

4. Components of Contractor Safety Management System

The Contractor Safety Management System has eleven components, (Figure 1). The processes are slight different between the initial phase (i.e., when the system is initially implemented during which contractors do not have a Safety Classification) and the ultimate phase (i.e., when eligible contractors have been assigned a Safety Classification).

Pre-Contract Award

(1) Determine Project's Safety Classification

The safety classification will be determined by two criteria, namely, location and nature of work (hazard). The system is shown in the following matrix:

Classification of Work → Classification of Location ↓	A	B	C	D
a	1	1	1	2
b	1	1	2	3
c	1	2	3	3

The Safety Classification has three levels of control requirements.

1 : High level of control requirements
2 : Medium level of control requirements
3 : Normal level of control requirements

Classification of Location

The classification of Location is determined by the location of work. If several locations with more than one classification are involved, the location classification with the most onerous requirements should be used first.

Location of Work	Sub-classification	Classification of Location
Station/Ancillary Building	Public Area	b
Control room or Plant Area	(a) Signal Equipment Room	a
	(b) High Voltage Room	a
	(c) All other areas	b
Platform		a
Amenity area		c
Depot	(a) Administration are	c
	(b) Workshop	b
	(c) Trackside	a
Running line, department & arrival track	(a) Tunnel	a
	(b) Viaduct	a
	(c) At Grade	a
Offices		c
Estates		c
Highway		b

Classification of Work

The Classification of Work is determined by the severity of consequences of the maximum credible event (incident or accident) caused by the hazard at work.

Classification of Work	Severity of Consequences
A (Catastrophic)	- Fatality of 5 or more people
B (Critical)	- Fatality of 1-4 people Major injury to 5 to 50 people
C (Serious)	- Major injury to 4 people or less, or Major injury to 5 to 50 people
D (Marginal)	- Minor injury to 4 people or less

(2) Invitation to Tender

Initially contractors do not have a Safety Classification, but the Corporation maintains a list of pre-qualified contractors. All suitable contractors will be given a reasonable opportunity to tender. However, in the ultimate phase, when all contractors have been assigned a Safety Classification, only contractors who have a Safety Classification equal to or greater than the project's Safety Classification will be invited to tender.

(3) Tender Documents

The tender document includes:

- General Specification, which will include safety requirements commensurate with the Safety Classification assigned to the project.
- Particular Specification, which will establish the time for submission of documents required, requirements to tie-payment to consent of safety documentation, training costs and arrangement, etc.
- A typical safety plan to show the contractors of the typical format and contents.
- A Safety Questionnaire to assess the contractor's commitment and capability in safety management.
- Training programme and costs to ensure that the tenderer considers this in his price and programme. In the longer term (ultimate phase), the conditions of payment will be linked to safety performance of the contractor during project implementation. Also a Safety Plan will be required to be submitted.

(4) Tender Submission

In accordance with the tendering schedule, the tenderer must submit the tender and all required information, together with a schedule of training dates.

(5) Tender Assessment

If a tenderer fails to produce an acceptable copy of the Safety Policy, this in itself will be sufficient reason to reject the tender. The safety questionnaire will be evaluated to assess the tenderer's ability to adequately manage safety, including the production of safety documentation and the availability of personnel. In the ultimate phase, the submitted Safety Plan will be evaluated.

Post-Contract Award

(6) Safety Plan and Method Statements

The Project Controller will require all safety documentation to be submitted within the time stated in the Contract. The Safety Plan will be assessed by the Project Team and compared to the typical Safety Plan for the appropriate classification of work. Similarly, method statements will be received from the contractor and consent given if satisfactory.

(7) Contractor Training and Identification

The Project Controller will identify the training requirements for contractor staff which, as a minimum, will include the supervisors. Where necessary, certain members of the contractor will be trained as Competent Persons and held responsible for supervising the work site. The training cost will be reimbursed if all training requirements are met. If a member of contractor staff fails on second attempt, he/she will usually not be allowed to repeat.

When a member of the contractor staff has been qualified as a Competent Person, he/she will be issued with an identity card. This identification will be checked by

Operating staff before allowing the contractor staff to work.

(8) Inspection

The contractor will be required to include an inspection programme in the Safety Plan. In addition, MTRC inspections will be conducted as a means of safety performance monitoring.

(9) Incident Reporting and Audit

Contractors will be responsible for reporting accidents and dangerous occurrences, to investigate them and to take corrective actions.

Also, the Corporation will conduct safety audits at regular intervals, to identify improvement opportunities in safety management.

(10) Safety Performance Review

The safety performance of the contractor will be reviewed periodically using a number of proactive and reactive criteria, such as accident rates and severity, results of inspections and audits, etc. The review report will be given to the contractor, who will be required to endorse or comment.

(11) Determine Contractor's Safety Classification

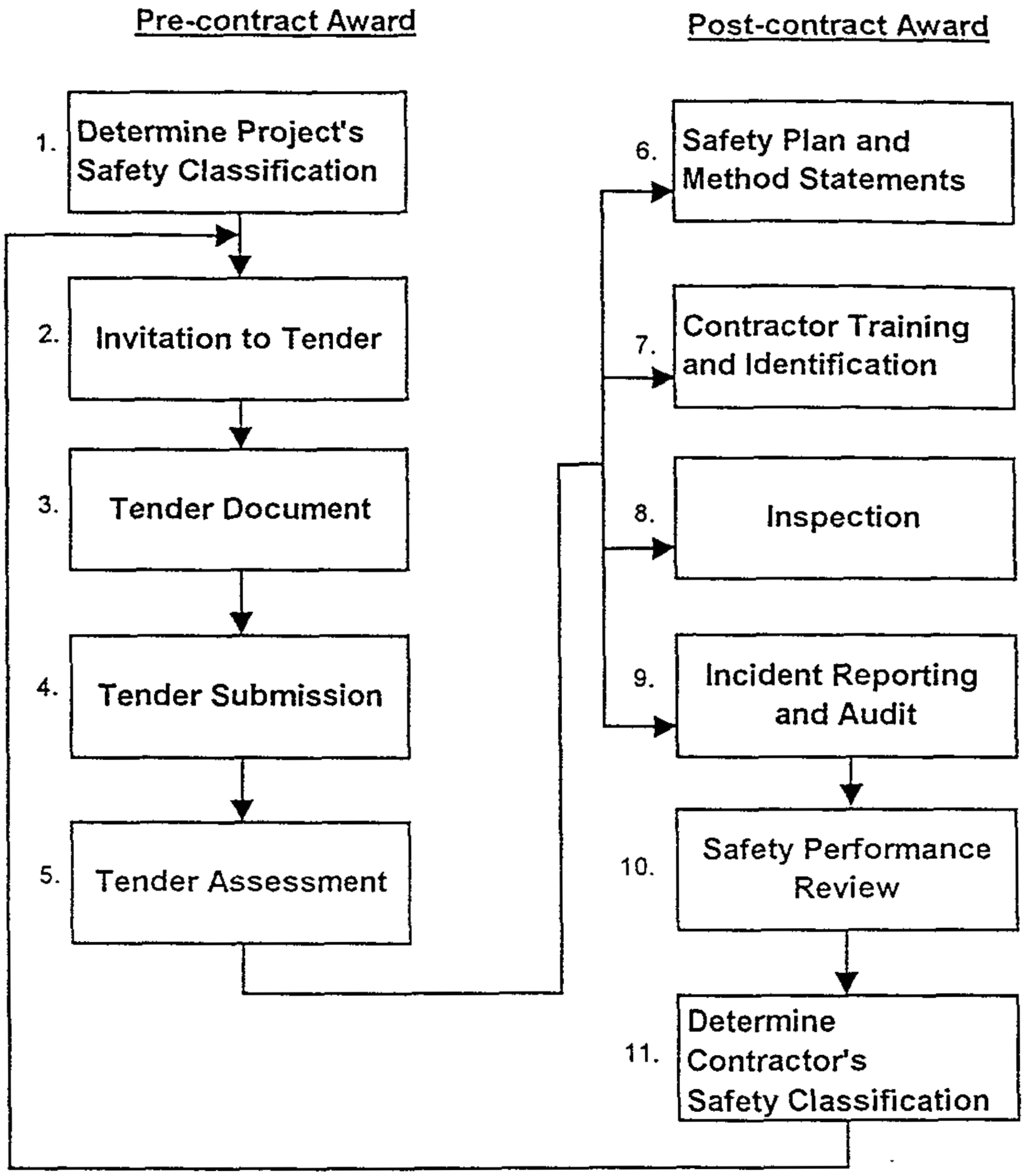
Based on the contractor's safety performance, an appropriate Safety Classification will be assigned to the contractor.

In the ultimate phase when the contractor has already got a Safety Classification, safety performance review during a project may result in the Safety Classification being revised or removed.

Figures 2 and 3 show the key processes of the Contractor Safety Management System, for the initial and ultimate phases, respectively.

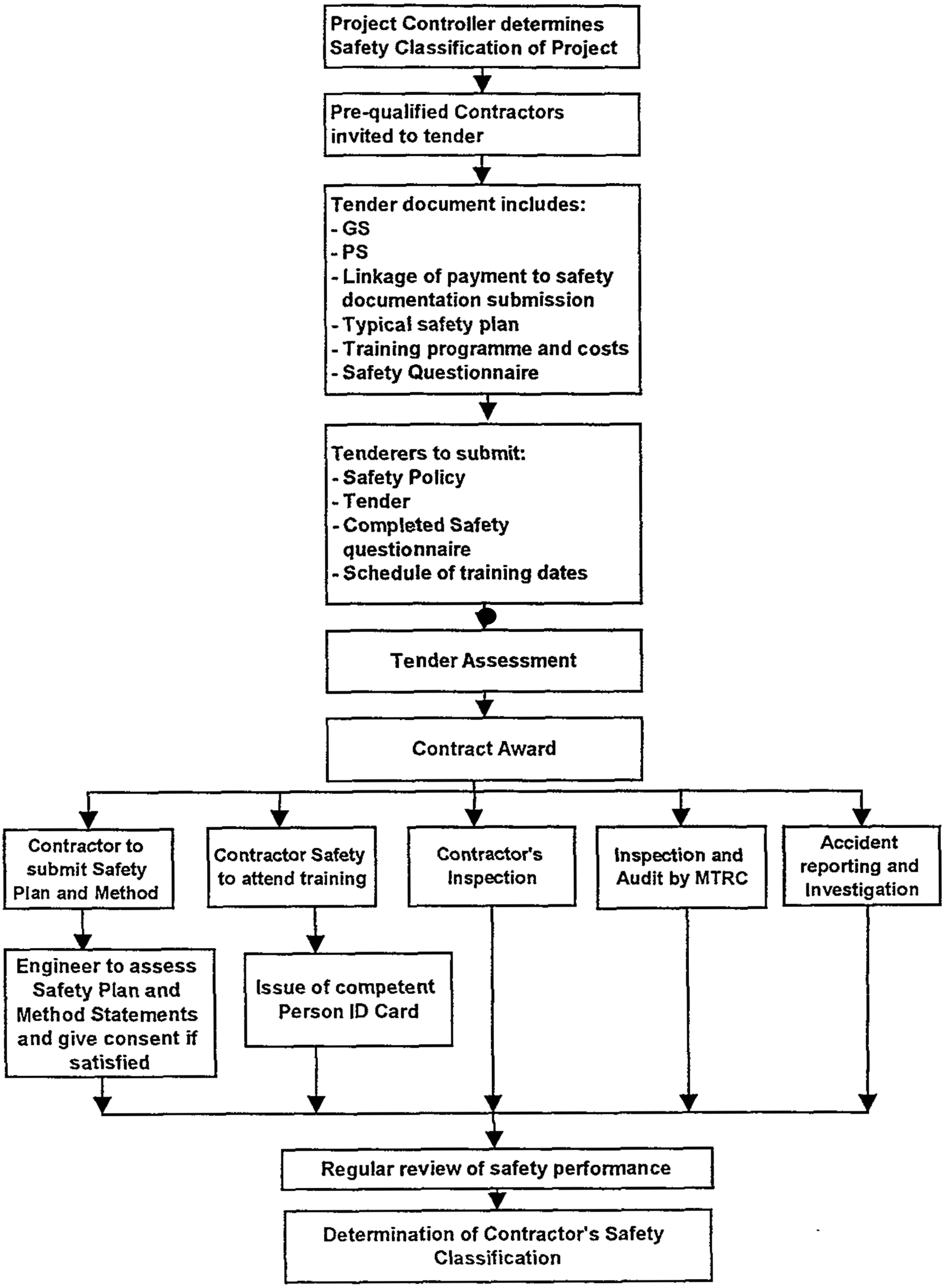
Figure 1

Components of Contractor Safety Management System



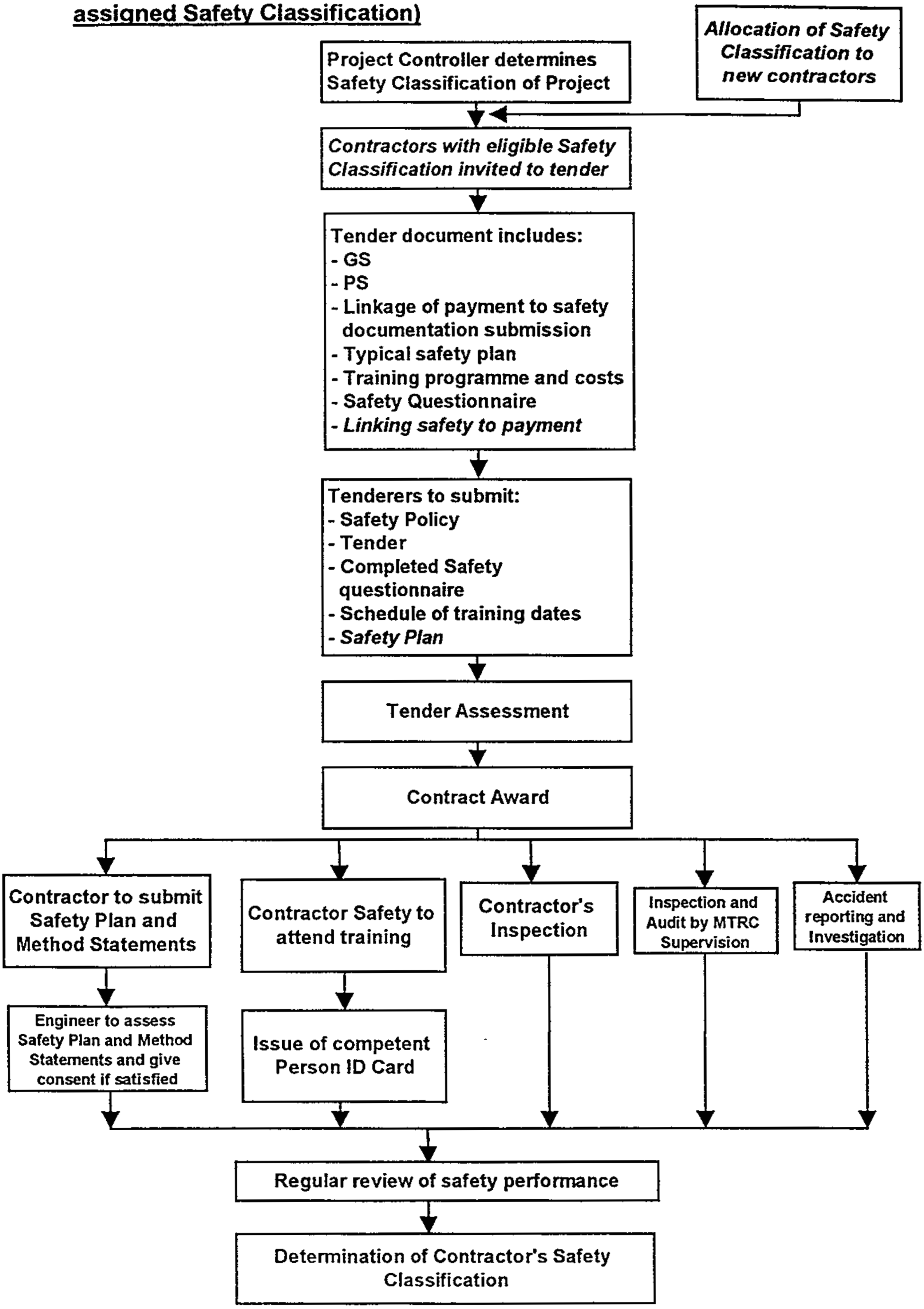
Contractor Safety Management System
Initial Phase (i.e., when contractors have no Safety Classification)

Figure 2



Contractor Safety Management System Ultimate Phase (i.e., when eligible Contractors have been assigned Safety Classification)

Figure 3



Note : Additional safety requirements in comparison with initial phase are shown in italics

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Dr M. H. Walter

Update on the UK Safety Case Regime

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V/7 Dr. M.H. Walter

Update on the UK Safety Case Regime

RAILTRACK SAFETY & STANDARDS DIRECTORATE

INTERNATIONAL SAFETY SEMINAR

MAINZ, 1995

UPDATE ON THE UK SAFETY CASE REGIME

Dr M H Walter
Head of Safety Validation
Railtrack PLC

Disaggregation of BR and the opening up of the railways to new organisations has given rise to many new safety issues: there are, for example division of control, new interfaces and other issues such as how newcomers are safely brought onto the network which did not arise under the monolithic structure of BR. Safety cases produced under the Regulations are called Railway Safety Cases and the Railway Safety Case regime is in place to provide a robust framework for setting out how each organisation will manage and deliver its safety commitments across the rail system.

Railtrack as infrastructure controller has responsibility for overall safety of all activities on its infrastructure. BR has split up into some eighty businesses which are moving into the private sector, there are existing operators such as London Underground operating on Railtrack's infrastructure, and there are also private sector companies coming onto the railway.

A fundamental requirement of the legislation is that each organisation is responsible for the safe management of its own activities and for ensuring that the activities of its contractors and suppliers do not import unacceptable risks into its business, i.e. a "safety cascade" with each level checking only the level below. Railtrack's RSC, which has been accepted by the UK Government's Health and Safety Executive (HSE), sets out how Railtrack manages the overall safety of the infrastructure and the operations on that infrastructure.

Train and station operators set out in their own RSCs how they safely manage their own and their contractors' activities on Railtrack's controlled infrastructure and in the main all such RSCs have to be accepted by Railtrack before access is allowed. Transitional arrangements exist until end February 1996 whereby organisations operating prior to implementation of the Regulations can continue to operate until that date without a RSC.

An important development at the end of last year was the interpretation by Railtrack (in conjunction with the HSE) that the RSC Regulations also applied to self propelled vehicle movements inside a possession or worksite: This has meant that even if say a track maintenance company only operates a tamper, or a road/railer in rail mode, an accepted RSC is required to cover the "steel wheel on steel rail" movements. I am of the firm belief that the demands and discipline of preparing and gaining the acceptance of an operator's RSC in order to operate in possessions has explicitly exposed the safety risks and clearly defined the controls and responsibilities for their management: even in the short term this will prove beneficial.

The process implemented by Railtrack for the acceptance of operators' RSCs has been in place since May 1994 and Railtrack has had to be very proactive in providing advice and guidance to the industry to make it clear what is needed to produce a robust acceptable RSC. An important part of the process has been to demonstrate to the HSE and the train operators that it is a fair and equitable process (e.g. that acceptance criteria do not become more onerous with time). From the start we have implemented detailed procedures and established clear audit trails throughout the process and we are justifiably proud in recently attaining ISO 9002 accreditation.

As at mid-September fifty-one RSCs have been submitted with twenty five having gained acceptance. There are currently a further fourteen RSCs expected to be submitted by the end of the year, all of these from private sector companies. In addition, some of the companies with accepted RSCs are already revising their RSCs in line with their business needs.

Timescales from formal submission of a RSC to acceptance by Railtrack has been highly variable. None have been right first time and have required various degrees of revision to achieve an 'accepted' status. The better ones have taken around 14 to 20 weeks and some are still in the process nearly a year after submitting. The principal contribution coming from the time spent in iterating out deficiencies. Organisations which utilise a strong project management approach with appropriate levels of competent resource as might be expected tend to fall into the better category.

During the past year Railtrack has implemented a Project Safety Case regime to cover health and safety issues arising from changes to its infrastructure e.g. resignalling projects.

The Project Safety Case is a Railtrack Safety Management System document that demonstrates how safety will be managed throughout each phase of a project life cycle and the document itself is produced by Railtrack.

In order for it to be an effective management tool it is a living document which is amended, updated and recycled in the light of changes. Sections are added, amplified or removed to fit the current purpose.

The Project Safety Case includes the following documents :-

- Safety Strategy
- Health and Safety Plan/Plans
- Health and Safety File
- Risk Assessment Reports

- Risk Log
- Emergency Response Plan
- Contractor Safety Case

A Contractors Safety Case regime is currently being implemented primarily to cover high safety risk activities such as maintenance, renewals or projects and include design, construction, procurement or management.

Contractor Safety Cases are not required for activities which do not impact on the safe operation of Railtrack's controlled infrastructure or for the supply of products. The nature of a Contractor Safety Case is dependent on the significance and complexity of the safety risks; it is not contract value dependent.

Guidance on what is required to be addressed in a Contractors Safety Case and the submission process is set down in a Railtrack Specification. In essence Railtrack seeks a demonstration by the contractor that he can undertake adequate hazard identification and risk assessment and has in place a robust SMS so as to undertake work in a safe manner which is acceptable to Railtrack.

It is the responsibility of the contractor to ensure he works in accordance with his CSC, keeps it up to date and agrees with the appropriate Railtrack contract manager any material changes.

Transitional arrangements have been in place to enable BR organisations to continue to provide services until they are privatised at which time the CSC must be in place. All new contractors must have an accepted CSC prior to start of work.

A number of organisational changes in Railtrack has required revisions to Railtrack's RSC and the opportunity has been taken to further revise the RSC in the light of experience.

The end result will be a document structured in a number of volumes or parts; a corporate volume and a volume for each of the directorates or divisions.
Ultimately the corporate volume will cover :

- policies
- principles
- standards
- processes

applicable across the company and the directorate volumes which show how each of the directorates achieves the policies, principles, standards and processes embodied in the corporate volume.

Each Directorate volume is in effect a 'mini' RSC based on a templated structure which contains information extracted from the Directorate's Safety Validation Case which is the tool for managing safety at the Directorate level.

So far the 'mini' RSCs cover the eight Zones and Property Directorate and we expect to cover Major Projects and the Engineering Directorate in the next issue at the end of the year.

In general, safety performance has continued to improve in Railtrack's first year of operation. Of the nine major safety indicators there was an improvement in 1994/95 in eight, with major improvements in passenger, staff and contractor injury levels and in passenger train collision and derailment rates.

To conclude, I believe that the implementation of the Safety Case regime is proving effective; it has gained general acceptance that it is not a paper exercise and is contributing significantly to the railways getting safer.

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Willem Kuys

Loss Control on a Mass Rail Transport System

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V/8 Willem C. Kuys

Loss Control on an Mass Rail Transport System

LOSS CONTROL ON A MASS RAIL TRANSPORT SYSTEM

South Africa exports 60 million ton of steam coal annually. This is done via the Coal Line of Spoornet, a division of Transnet, from the major coal fields in the Witbank area to the Port of Richards Bay This coal export line is approximately 650 kilometres long and 200 wagon trains with a nett coal mass of 16 800 ton each is used to transport the coal to the coal terminal in Richards Bay. 15 Million ton of other commodities are also transported over this railway line for export through the Port of Richards Bay.

The export of coal annually earns R6 000 million ($ 1 640 million) of foreign exchange for the Republic of South Africa. Coal exports is also the major income generator for Spoornet. There is no doubt about the importance of the Coal Line to Spoornet, the local coal industry as well as the South African economy in general. South Africa exports 13 % of the world's total traded seaborne steam coal. The RSA is however the only country where the total coal export tonnage is conveyed over one rail corridor to one port terminal

It is obvious from this abovementioned that the risks associated with the Coal Line deserves special attention. The process of determining a risk profile (risk assesment) for the Coal Line as well as how the rest of Spoornet can impact on the Coal Line in case of a major disruption will be discussed in this paper.

The risks associated with the export of coal was realized by Spoornet and it was decided to conduct a detail study to properly asses the risk of this major business to the company

2/...

At the time the decision was made to conduct this study in 1994, Spoornet did not have the detailed specialised know-how to undertake this study. For business reasons it was also realised that employing consultants to analyse Spoornet's major business component in detail, also involved a major risk. This was no negative reflection on any consultant, but it was regarded as too great a risk, especially seen in the context that a major long term contract with the coal industry was to be negotiated in 1994/95, to involve outsiders into detailed business analysis.

To gain the necessary know-how it was decided to conduct a study to determine the risk profile on two another transport corridors, namely the Durban main line and Pretoria to Beit Bridge line. These studies were done in conjunction with consultants abroad with the specific purpose to train Spoornet staff in conducting detailed risk assessments. These studies as well as the training of Spoornet staff were completed in November 1994 and May 1995 respectively.

The study concerning the Coal Line differed substancially from the previous exercises. Whereas the former assesments concentrated on the possible incidents associated with the transportation of dangerous goods and the effect on society and the environment the assesment of the Coal Line involved much more. The main goal in the latter case was to determine what effect interruptions would have on business that was related to the Coal Line. The fulfilment of contract obligations, insurance coverage required and asset utilisation were the important business related areas.

The study concerning the Coal Line was subsequently done. Broad risk areas were identified and more detailed analysis are now being done to quantify these risk areas. The detailed study covers the following specific areas:

3/...

i) Staff items such as training, competancies and manning of posts

ii) Infrastructure related items covering signals, overhead traction power equipment and civil engineering

iii) Rolling stock covering locomotives and railway wagons

iv) Communication systems

v) Operational practices including scheduling and the influence of traffic joining the Coal Line

vi) External factors such as sabotage, major external suppliers and acts of God.

The following interesting facts came to light during this study.

i) The double railway line passes through more than 40 tunnels. Only one tunnel, the Overvaal tunnel, is single and 4 000 meters long. This is the most strategic place, amongs other "hot spots", on the entire railway line No alternative detour for coal trains is possible on Spoornet's network.

A special "Risk/Loss Assessment Profile" computer program will be utilized to determine the impact at disruptions of this and other strategic important sites. These studies are not yet completed.

ii) The risks that Spoornet activities impose on the environment and people living

4/...

along side the railway line became obvious. This is of particular importance with the spillage of coal in streams and waterways in the event of derailments. These risks are enhanced if Spoornet decides to transport large volumes of hazerdous material over this railway line.

iii) It was further realised that the management of the Coal Line caused reason for concern. The managment of the Coal Line in particular has special skills that were accumilated our years of operational experience. This know-how is passed on from "old" staff to new-comers. These skills are unique in Spoornet as no other commodity is transported likewize on Spoornet. In fact, no similar system exists worldwide that matches intensity of volume and scale of efficiency.

As the management structure is fairly shallow on the Coal Line, any significent outflux or loss of management staff will negatively influence operations on this line. The detrimental effect on Spoornet, the coal industry and South Africa as a whole, will be enormous. Special attention should be given to the management component of the Coal Line. Competencies should be properly documented, the management depth should be increased by training and successor planning should be implemented.

With the preliminary results of the study available at this in time the following procedure will be followed to identify problem areas for management actions;

i) Risks will be quantified as far as possible in monetary terms, and grouped in a priority list

5/...

ii) Risks that cannot be translated into financial terms must be coupled to the priority list subjectively

iii) The risks identified will be dealt with in the following manner:

- a) Catastrofic risks with a low frequency of occurrance will be covered by insurance
- b) Medium frequency large risk areas will be managed down to acceptable levels
- c) High frequency low risk items will be self insured
- d) The aim is to manage the risk profile down to international accepted norms.

The analysis of risks on a portion of a railway network is more complex than the eye meets. On face value the inter-relationship, between the railway section under scrutiny nd the remaining rail network must not be underestimated. The support from the rest of Spoornet significantly effects the risk evaluation of the Coal Line positively compared to an academic stand alone Coal Line. This will be demonstrated by a practical case study where a major derailment occured on the Coal Line in October 1994.

The derailment was caused by a wagon wheel that cracked because of manufacturing defects The possibility that more wheels might crack resulting in more derailments was high and it was decided to withdraw all wagon wheels from the same manufacturer. This resulted in 800 wagons being withdrawn from service untill the defected wheels could be

6/...

replaced. The total coal export wagon fleet at that time numbered 6 500 wagons. This precaution serverely impinged the rail service as coal was exported at the maximum possible rate as result of a upswinging in world demand for steam coal. Spoornet and the coal industry were to loose substancial in terms of revenue.

The following actions where taken to alleviate the situation;

i) The building rate of new wagons under construction was increased
ii) The number of wagons under repair at maintenance workshops was reduced drastically. This in particular applied to wagons under heavy repair, such as the renewal of bodywork, that could be deferred.
iii) Wagon wheels destined for the rest of Spoornet's operations were redirected to the Coal Line
iv) The manufacture of new wheels by contract was increased.
v) Special teams to replace wheels were sent from other depots to the Coal Line to assist in the replacement of wheels
vi) Whole train sets with defective wheels were compiled and continued to transport coal under a heavy speed restriction and limited to 100 wagon train lenghts (Normally 200 wagon trains are operated)
vii) 14 Additional locomotives were sent to the Coal Line to haul the additional 100 wagon trains

The result of all these actions was that normal volumes of coal were transported 5 weeks after the derailment. Normal operations, that is after all wheels were replaced and 200 wagon trains were fully operational, only resumed 18 weeks after the derailment.

7/...

The abovementioned proved that, with the broader support from Spoornet as result of the resources available to Spoornet, the service level on the Coal Line could be resumed much earlier than if the Coal Line was a stand alone railway operation In analysing risks of a portion of a larger railway network certain risks must be adjusted and take account of the advantage of resources available elsewhere for recovery. This same principle is applicable for neighbouring railways. This is of course only valid if an agreement for support exists between the railway authorities involved It must be further pointed out that this reasoning is only valid to reduce recovery time and limit revenue loss. This will not effect the direct damage costs of a mishap

This paper gives on overview of the prosess Spoornet followed to determine the risks on the portion of their network applicable to coal exports. The major risk areas identified are being analized in more detail to asses remedial action It is illustrated that risks on a portion of a rail network cannot be looked at in isolation. Resources, available on the rest of the railway network can substantially reduce recovery time after major disrubtions. These risks can also be reduced with agreements between similar neighbouring railways.

WC KUYS
ASSISTANT GENERAL MANAGER (RAIL OPERATING)
September 1995
a:e01/ejk

International Rail Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9528

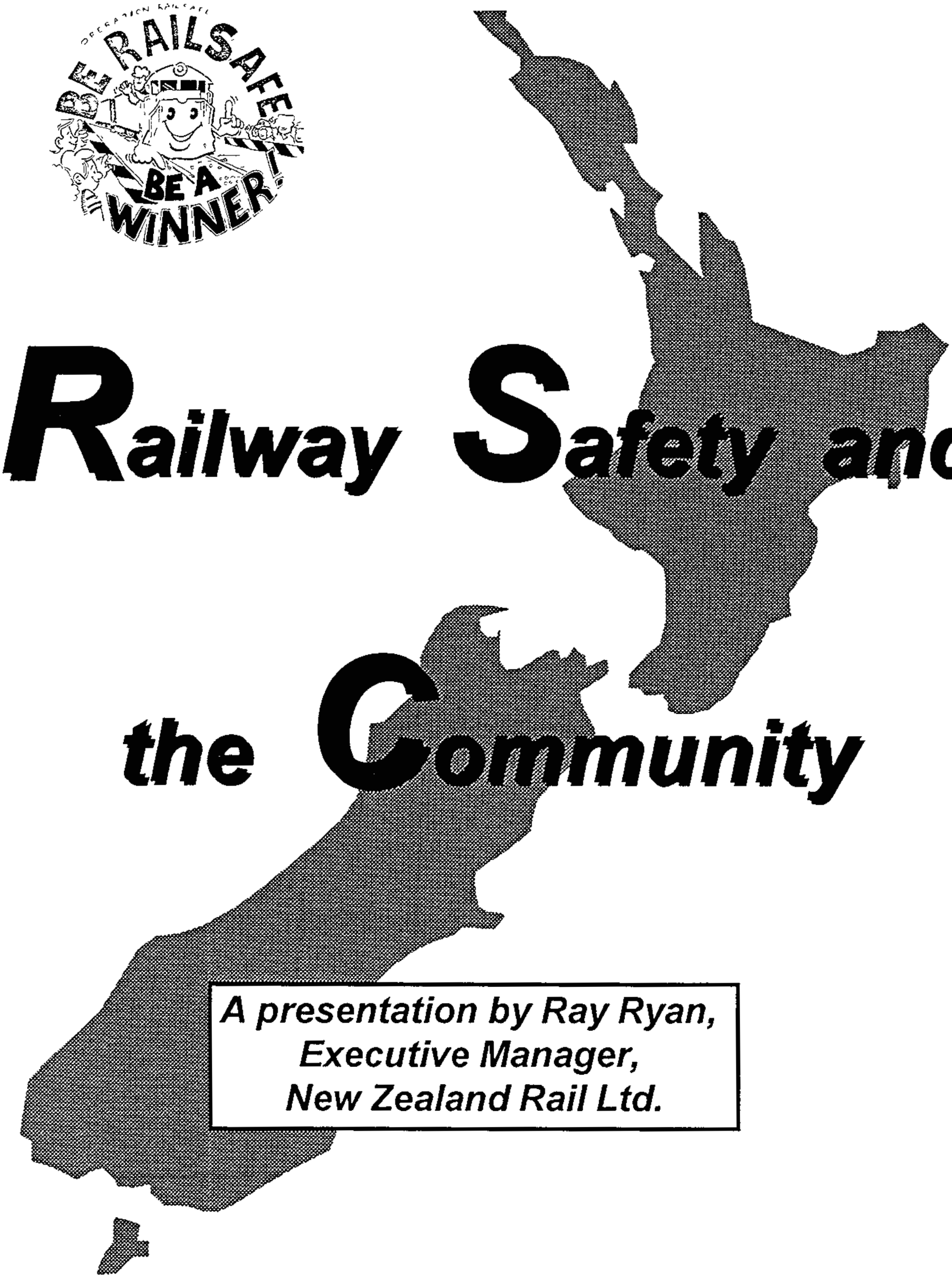
Ray Ryan

Railway Safety and the Community in New Zealand

Publisher
2000 International Rail Safety Conference

V/9 Ray Ryan

Railway Safety and the Community in New Zealand



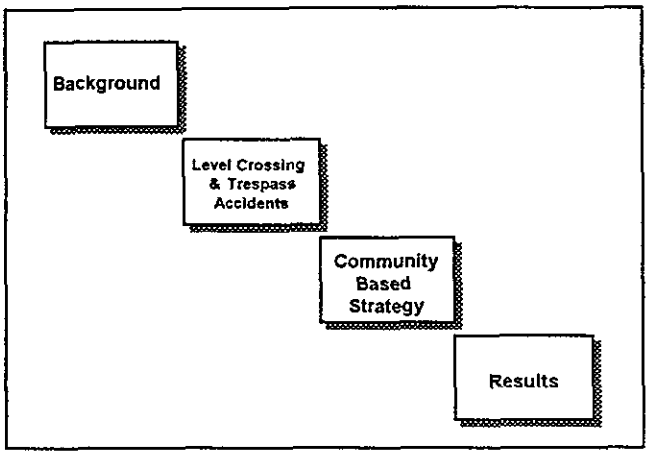
Railway Safety and the Community

A presentation by Ray Ryan,
Executive Manager,
New Zealand Rail Ltd.

Railway Safety and the Community

SLIDE

YOUR NOTES

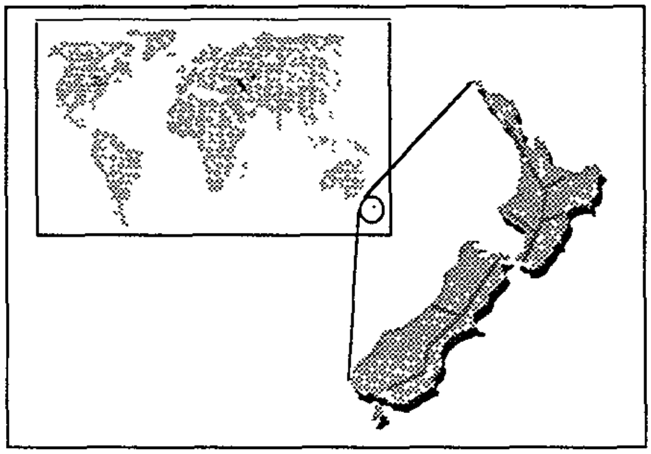


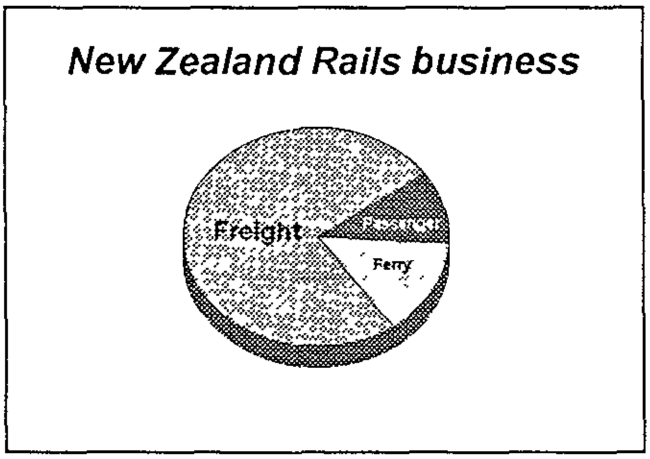
Background

Level Crossing & Trespass Accidents

Community Based Strategy

Results





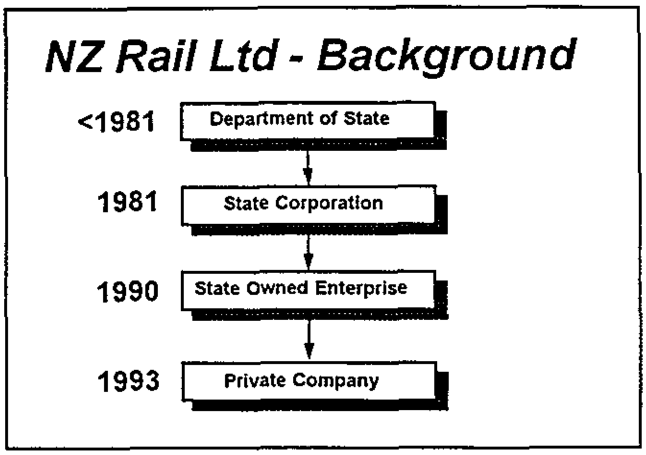
New Zealand Rails business

International Railway Safety Seminar - October 1995
A presentation by Ray Ryan, New Zealand Rail Ltd

Railway Safety and the Community

SLIDE

YOUR NOTES



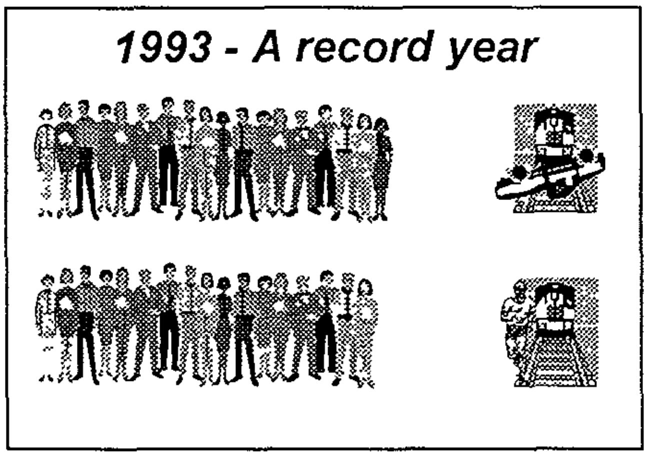
NZ Rail Ltd - Background

<1981 Department of State

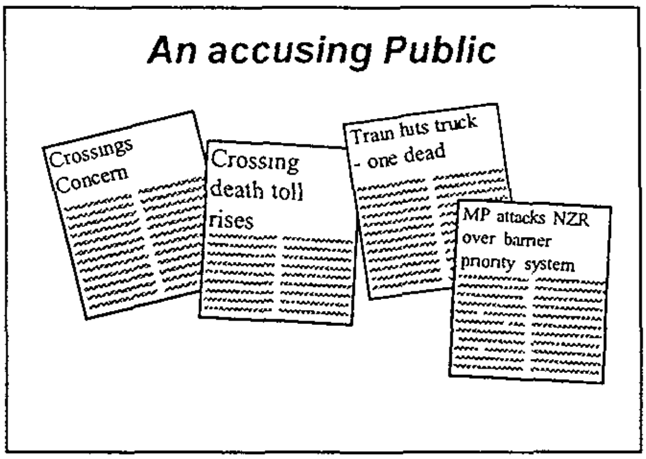
1981 State Corporation

1990 State Owned Enterprise

1993 Private Company



1993 - A record year



An accusing Public

Crossings Concern

Crossing death toll rises

Train hits truck - one dead

MP attacks NZR over barrier priority system

Railway Safety and the Community

SLIDE

YOUR NOTES

The New Company

✓ Railway Safety & Corridor Management Act 1992

✓ Leadership in community activities

✓ Public image

The issues in 1993

✗ Level crossing accidents

✗ Trespassers

✗ Rail at fault

✓ Road-Rail-Community preventative systems

✓ Community responsibility

The 2 year strategy

➪ raise awareness

➪ change public perception

➪ children - schools

➪ involve staff

➪ work with interested external parties

➪ use media

"OPERATION RAILSAFE"

Railway Safety and the Community

SLIDE

YOUR NOTES

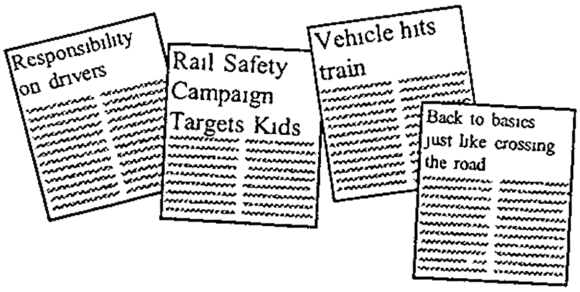
"OPERATION RAILSAFE"

- ☺ New Road Code
- ☺ Video
- ☺ Police prosecutions
- ☺ Phone Card
- ☺ Peter Brock
- ☺ Local Councils
- ☺ School programme

School programme

- 💣 **Hazards**
  - at Level Crossings
- 💣 **Danger around railways**
- 💣 **Trains**
  - heavy
  - hard to stop
  - silent
- 💣 **Extra set of eyes**

Public perception changes



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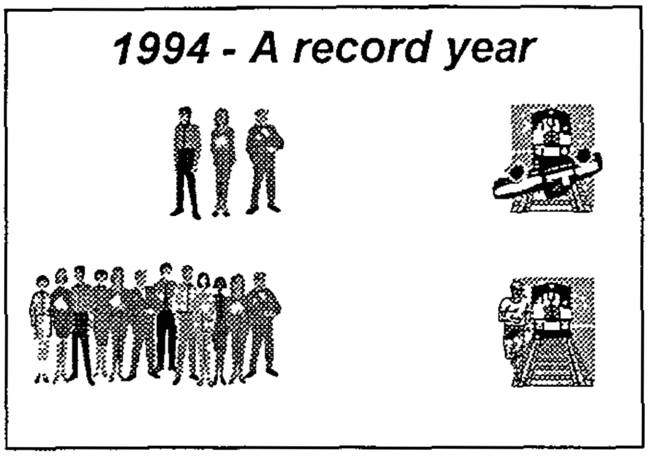
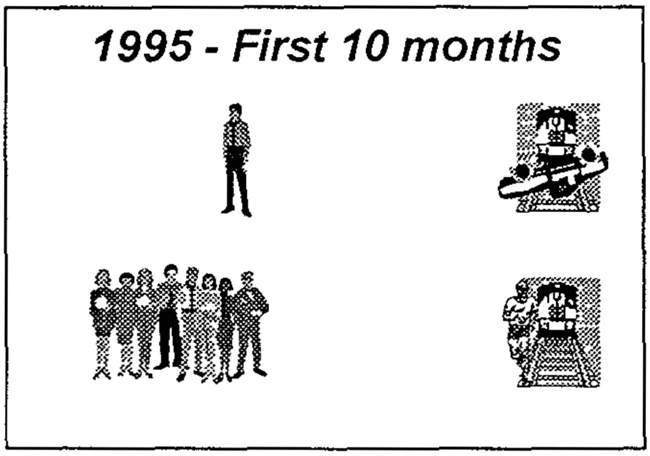
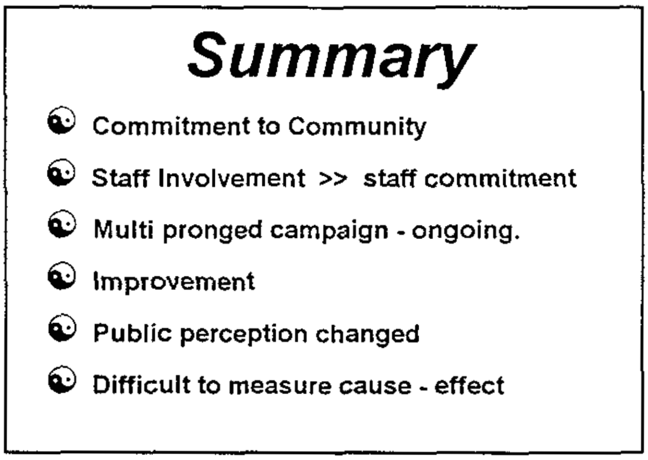


1994 - A record year



1995 - First 10 months



Summary

- Commitment to Community
- Staff Involvement >> staff commitment
- Multi pronged campaign - ongoing.
- Improvement
- Public perception changed
- Difficult to measure cause - effect

INTERNATIONAL RAILWAY SAFETY SEMINAR
1995

"Railway Safety And The Community in New Zealand"

Ray Ryan
Executive Manager
Quality & Safety
New Zealand Rail Ltd

October 1995

RAIL SAFETY AND THE COMMUNITY

Ray Ryan
Executive Manager, Quality & Safety
New Zealand Rail Limited

Paper to International Railway Safety Conference
Germany : October 1995

The Catalyst

In 1992, the New Zealand Government passed the Railway Safety & Corridor Management Act, the cornerstone legislation for railway operators in New Zealand.

One of the base elements of the Act is the right of railway operators to assume that the line is clear of hindrance or obstruction In essence, rail operators are entitled to assume they have automatic right of way that all persons, animals and vehicles, will be clear of the line, and by inference the onus of safety is as much in the hands of those traversing a level crossing as on the rail operator.

However, in 1993, a record number of people were killed in level crossing accidents While the number of accidents had fallen, 3 accidents claimed 12 lives. There were 18 fatalities in 1993 compared with 7 in 1992. There were also a number of serious accidents in urban areas involving people who trespassed on railway land.

In 1993, an accusatory public spotlight shone brightly on New Zealand Rail

The Actions

There is an adage that you cannot fight an emotional issue with a logical argument This was very much the situation New Zealand Rail found itself in in 1993

One of the main aspects of New Zealand Rail's focus since privatisation in 1993 has been the acknowledgement that many of the factors which influence the Company's performance and public image emanate from outside its organisation.

Privatisation also increased the need for the Company to be seen to be taking a leadership position in community activities In 1993, the focus on the community was crystallised by the level crossing issue.

The Company's approach to the issue was holistic. Level crossing accidents and trespassing on railway land were not the core issues. The issues were safety and responsibility.

To integrate its rail the safety messages, New Zealand Rail summoned support from outside agencies, sponsors and personalities.

- New Zealand Rail worked with the Land Transport Safety Authority, and jointly sponsored, a redrafting of the Road Code, the manual containing road driving rules. Crucially, the new Road Code included an enlarged section on level crossing safety.
- A video aimed at teenage drivers, co-sponsored by oil company Shell, featured a section on the potential dangers of level crossings.
- The support of the Police was actively sought, and obtained, to press for prosecutions where drivers had driven through warning devices at level crossings.
- A mobile display featuring a car that had been struck by a train was made available for display for interest groups around the country.
- Telephone cards with a simple rail safety message were issued.
- Peter Brock, a motor racing star in Australia, made himself available to appear on posters advising rail safety. Mr Brock has since been used extensively as the face of road safety in New Zealand through a series of high profile television commercials.
- New Zealand Rail's internal security team became involved. Part of their responsibility was the safety and security of operational railway areas to ensure the security aspects and integrity of the rail network.
- Media were actively encouraged to visit rail sites to observe community behaviour patterns that could lead to safety risks.

The aim of this integrated campaign was not to scare, intimidate or threaten people. It was successfully positioned as a sharing of responsibility for safety at the interface of the two transport modes.

Operation Railsafe

The campaign was for the adults of the future. A series of focus groups determined that the 8-11 year old age group should be targeted through their schools and through the general teaching curriculum.

The teaching aim was four fold:

- potential hazards at level crossings;
- dangers of playing around rail yards;
- the physical nature of trains (heavy, not easily stopped, silent); and
- be an 'extra set of eyes' for, and thereby teaching, their parents

Again, the intention was not to dissuade children from enjoying trains, but to make them understand the safety issues.

Operation Railsafe, as the programme was dubbed, entailed a mix of classroom activities and practical demonstrations at rail yards. Under very strict supervision, children were allowed to push wagons and then try to drag them to a halt, asked to close their eyes as a wagon silently rolled past them, and were shown the power and weight of a train by having it run over pieces of wood on the track.

Perhaps the most graphic aspect of the demonstration of the need for rail safety was the inclusion, as a Presenter, of a young man who had narrowly survived being killed after playing 'chicken' with a train. Jason Percy still carried the physical and mental scars of that experience, and he was a valuable asset to the *Operation Railsafe* programme.

Ownership of the safety issue was important for New Zealand Rail staff. The programme was presented by New Zealand Rail staff, some of whom had first hand experience of rail accidents. Staff were involved early in the campaign through a competition to coin a suitable slogan for the programme, "Train your Mind to Mind the Train", which was used extensively in publicity material. It instilled into staff the need not only for personal safety in rail environment, but also the value of a well executed public awareness campaign.

More than 50,000 school children have no taken part in *Operation Railsafe* and have been taught important long term safety lessons. The programme also earned the Company the Public Relations Institute of New Zealand award for outstanding long term public relations campaign.

The Outcomes

In 1994, there were just 3 level crossings deaths in New Zealand, and in the first 8 months of 1995, only one person has died. The visibility and the change in public and media opinion regarding rail accidents, including the dangers of trespassing in operational rail areas, was markedly heightened.

It would be naive to suggest that the publicity surrounding the level crossings, rail safety issues and the community based campaigns were solely responsible for such a dramatic turnaround in rail safety and awareness.

The effectiveness of such campaigns cannot be measured with any certainty. Indeed any rail company must use as its community education philosophy that it has, to the best of its ability and resources, tried to educate the public about such aspects of level crossings and rail yard safety and, thereby minimising the risks through public awareness.

For example, in the New Zealand Rail example, the erroneous perception of "train hits car" has been turned around, and there is now much greater public acknowledgment that level crossing safety is a road as well as rail issue.

Conclusion

In 1994, the Company introduced a Committment Statement, identifying staff, customers, the community and shareholders as its four major influence groups. While safety is an important issue for all these groups, the most visible externally is the community, the community which includes, customers, staff and shareholders.

It is quite clear that the level of public awareness of all rail safety issues in New Zealand has been significantly raised for the better.

■

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Responsibility on drivers

Christchurch

A Christchurch traffic sergeant has placed the responsibility for safety at level crossings firmly back on the motorist in the wake of calls for NZ Rail to update warning methods.

NZ Rail says there have been 17 fatalities involving trains and level crossings this year and 79 collisions between trains and cars on crossings.

It has been criticised by the Road Transport Association, which claims negligence on the part of the company is a "major contributing factor" in the fatalities.

But Christchurch Senior Sergeant Alan Dando today said motorists had to take responsibility for driver behaviour at the crossings.

"I have yet to see an inadequately signposted crossing," he said.

"It falls back on the driver. Motorists must approach railway crossings prepared to stop," he said.

"The crossings should be treated like a defensive driver treats a green traffic light. If the bells and lights are not in operation, they should anticipate they could start on their approach to the crossing."

Mr Dando, in charge of the traffic infringement bureau for North and Mid Canterbury, said 14 drivers in the region were due to come before the courts on at least 20 charges involving rail crossing misdemeanours.

In August the Southerner train collided with a fully laden cement truck, killing three passengers. As a result the truck driver faced three charges of careless driving causing death and four charges of careless driving causing bodily injury. — NZPA

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Rail safety campaign targets kids

LOCOMOTIVE drivers are upset at seeing children playing near tracks, NZ Rail says.

The company recently launched Operation Railsafe at Hornby School, Christchurch, and that will be followed by a North Island launch.

The campaign is targeting hotspots to make children aware of the potential dangers of railway tracks, yards and platforms. Schools near the main trunk line will be a priority.

Marton and Feilding are among main trunk line problem areas, where locomotive drivers have expressed concern about children playing close to the tracks.

NZ Rail operations team leader Vic Hewson said the company chose to target children because locomotive drivers were upset at seeing children playing near tracks, unaware of the danger.

"Today's children will be the next generation of drivers and it is important to educate them about the potential hazards of railway tracks," he said.

During Operation Railsafe, groups of school children would be taken to their local rail yard to graphically show them the consequences of playing around trains and lines.

"The supervised demonstrations include a piece of wood, about the size of a child's leg, being placed on tracks and run over by a train. This shows exactly how heavy and powerful a locomotive can be."

Other demonstrations involved children closing their eyes and trying to guess when wagons were being shunted past them.

"They cannot tell when the train is arriving. This is a great way to show them how quiet trains really are, and that they should always use their eyes before their ears," Mr Hewson said.

After the yard tour, children were given a short presentation at school and discussed the demonstrations and other safety issues. NZPA

Lunch tickles public

TAXPAYER-funded jollies always pull in the crowds and I am sure many females in public employment instantly took the opportunity to chomp their way through the thousand dollars worth of free saveloys organised by the Ministry of Women's Affairs.

I cannot quite recall anything that has ticked the public imagination like the Government's Lesbian Lunch.

Everywhere, I encounter people talking about it, which is why I am discussing it now.

At worst it broke the monotony of public sector life at that end of town, and I must concede that most of the blokes who work at that part of Wellington are pretty uninspiring anyway, being of a somewhat milquetoast and wimpish demeanour.

Hardly the fellows to curdle the blood of the lasses who work around Parliament, who I find of an altogether more determined temperament anyway.

Islanders

I AM only sorry that an invitation was not extended to the dozen or so Lesbians by birth who live in Wellington.

I refer of course to several of my friends who hail from the Greek Island of Lesbos.

It was the Island of Lesbos in Greek mythology which gave us the work lesbian.

I am sure a few of these rugged Lesbos islanders now living in Wellington with their Anthony Quinn personalities and looks might have had a profound effect on this piquant lunch.

Where is he now?

NDER what happened to JOHN
was the Englishman who
Zealand as if it were

Ordinary Bloke

am aware of in which an individual has made a livelihood out of forecasting some kind of catastrophe at Rongotai.

Meanwhile, the airport has pursued its ultra safe record and Mr Bruce has disappeared from the scene.

Level crossings

I AM sorry, but I cannot go along with the notion that the railways management is in any way responsible for the rising deaths at rail/road crossings.

It is the sheer bloodymindedness of so many drivers that is at fault here. "I'm a Kiwi. I'm proud of myself — and no bloody klaxon, red lights, and swinging arms are going to tell me when I can cross the road", is the unfortunate causative attitude here, I am very much afraid.

Planning blitz

AM I the only one to get nervous about the current Wellington City planning blitz? As I have said before, the only reason Courtenay Place has become one of the southern hemisphere's boom [illegible] is because it just happened. Planners would somehow have stymied it.

There is a planning euphoria starting up that has me worried. Experience has proven beyond doubt that we are looking at big ratepayer expenditure for monuments that nobody needs or wants.

Baches

WHY are the beach baches along the coast the subject of so much hostile bureaucratic attention? Many lives h
been saved along lonely coasts b
bach dwellers.

Most of these qua
destroyed by

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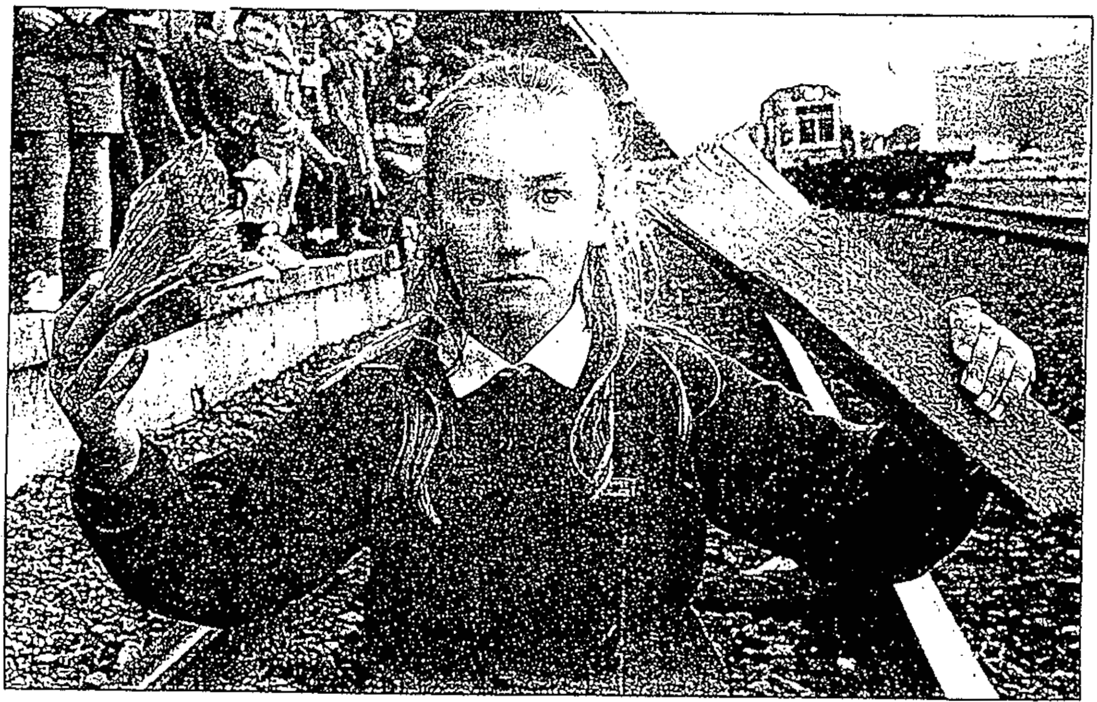


Nine-year-old Alana Lindsay from Timaru Main School yesterday learned what could happen to her legs if a train rolled over her. Snap ... the broken timber was part of a touring Railways education programme designed to warn children off playing on rail tracks. — Photograph by John Bisset

Waikato Times

WEDNESDAY, NOVEMBER 10, 1993

Back to basics — just like crossing the road

Stop, look and listen before you cross the road. Look right, look left and right again before you cross the road. Such admonitions have been so well drilled into New Zealand youngsters that translating instruction into action becomes second nature throughout their lives. The message is simple, basic and effective, and has made a major contribution to road safety.

The deaths of four men last weekend in a crash between a car and the Kaimai Express train at a Huntly level crossing underline the need for road users to get the message about caution at train crossings. In the past few years the annual average number of such fatalities is about 16. This year 25 people have died in crossing accidents, five in a single car-v-train collision. Others have been seriously injured, while a few have emerged unscathed. Some dice with death — like the five men in a car parked on a Hastings railway line this year who argued about whether an approaching light really was a train. It was, and it slammed into them, though no one was injured. One passenger was concerned only about rescuing his beer from the boot.

But there is always someone in vehicle-people-train collisions, often overlooked or forgotten, who suffers emotional scars: the train driver. People who drive trains are powerless to take evasive action in so many circumstances. They can sound horns and apply brakes, but beyond that can only wait in dread for the inevitable impact. Often they are the first at the accident scene, so the horror of first-hand experience of the resultant injury or death is imprinted indelibly on their minds. One Hamilton train driver who went alone to check an accident victim discovered the man had been decapitated. That driver was subsequently involved in a second crossing fatality while in control of a train. Understandably, some drivers quit their jobs because of accident-related stress. NZ Rail has, in recent years, provided counselling for drivers after accidents, but some still lose their livelihoods by being the innocent victims of others' carelessness.

To its credit, NZ Rail has initiated a range of measures to cut the crossing toll. It has made submissions enlarging on existing information in the Road Code about crossing, contributed to a road-safety video on driver behaviour which will be issued to secondary schools next year, and run pilot programmes in two primary schools this year to lift crossing awareness of primary school pupils.. Safety measures at crossings range from passive signs which are the lowest level of protection, through the intermediate level of bells and lights to the highest level, half-arm barriers. But while accidents such as the Huntly one trigger calls for barrier arms — and the Huntly crossing has risen on the priority list after the fatality — they are at best prevention, not cure. Barriers at a Waiouru crossing are rammed almost every month. The real answer lies with road users. When barrier arms are down, lights flash, bells ring or a sign is displayed, they should treat crossings with the same caution as intersections. Ignoring warnings or taking risks means blame for any ensuing accident rests with them. Now, if they had only stopped, looked and listened before they crossed the tracks . . .

Extract from New Zealand Rail's 'Expressions' Monthly Staff Magazine

EDITORIAL ◆ COLUMN

Three tragedies in 16 days turned the public's attention to the potential dangers at level crossings.

Safety in the spotlight

The accidents have generated much media coverage and there have been many opinions given as to how and why the accidents occurred and, more importantly, how they can be avoided in the future

It is a unfortunate that accidents involving trains, whether it be the fault of Rail or not, are inevitably referred to as train accidents.

However, we are slowly turning peoples' attitudes around by showing that the vast majority of these accidents are road accidents that happen to involve a train. A train weighing several hundred tonnes can't stop on a five cent piece and it can't swerve to avoid danger.

We have been driving home the message that signs, flashing lights, bells and even barriers are only warning devices - people ignore them at their peril.

Individually and as a Company we must ensure the safety message gets across. That responsibility lies with all rail staff, 24 hours a day, seven days a week.

Planning for a safety campaign was underway before the recent accidents and several key audiences were identified.

The Company is working on a safety campaign aimed at school children - if we can get the message to stick when people are young it may help to prevent tragedies in the future.

We are also working closely with the Land Transport Safety Authority and the police about giving level crossings a higher profile in the Road Code and in their publicity and safe driving campaigns Other groups we are working with include Transit New Zealand, which is in charge of roading, and the Road Transport Association which covers the nation's truckies "

However, we cannot expect the public to understand every part of our business - many people have little or no contact with rail

What we must get across to all New Zealanders is the need to use common sense and take care at level crossings

If we can achieve that we will have succeeded

Finally, I would like to record my admiration and heartfelt thanks to all those staff involved in recent incidents for the extremely professional way they have conducted themselves

Accidents such as these are very emotional for the staff involved. To a person, they have been a credit to the company

Francis Small

Francis Small
Managing Director

Extract from New Zealand Rail's Expressions Magazine

Operation RailSafe launched

Reporters, photographers and a television crew recently joined children from Hornby School in Christchurch for the launch of New Zealand Rail's schools safety programme, Operation RailSafe.

Operations Team Leader, Vic Hewson, says the programme is aimed at 9-11 year olds and will be presented by volunteers from NZ Rail staff.

"It's important we get the rail safety message across to kids of this age as they are an 'at risk' group, and will also be the drivers of tomorrow."

Vic's next task is to train staff how to present the programme so it can get it up and running around the country. Staff from Christchurch who volunteered to present Operation RailSafe attended the launch to see first hand how the sessions are run.

"The response from staff so far has been great with more than 110 volunteers from all around the network offering to take part," says Vic

Anyone who would like to take part in Operation RailSafe should contact Vic on ext 44018. ■

NEW ZEALAND RAIL'S
commitment

New Zealand Rail will be New Zealand's leading provider of transport solutions and travel experiences

For our customers we will
- *enhance value*
- *be competitive in price and service*

For our people we will
- *encourage participation*
- *be a good and fair employer*

For the community we will be
- *environmentally responsible*
- *safety conscious*

For our shareholders we will
- *grow the value of the Company*

and in all ways we will strive for excellence

New Zealand Rail

Extract from New Zealand Rail's 'Expressions' Monthly Staff Magazine

Picture perfect

Managing director Francis Small (right) and security manager Vic Hewson judge the safety posters drawn by 10 and 11 year olds at Taumarunui Primary School.

The school was one of the first to take part in the pilot scheme for a safety programme for school children Since then local train examiner Nigel Hearn has presented the programme to a further four schools in the area with great success

The prize for the winners of the poster competition were given a wrist watch and ride in a shunter in the local railyard ■

Giving safety a push

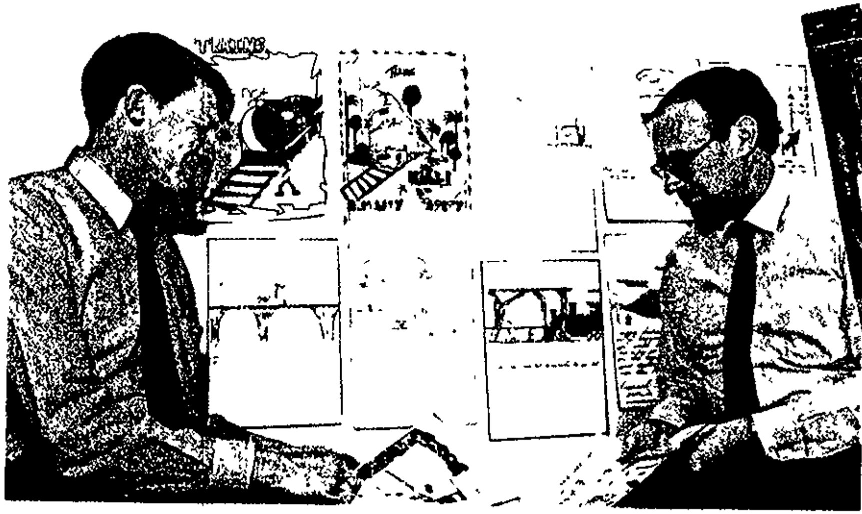
Heave! Pupils from St Patrick's school in Masterton put their weight behind a loaded wagon to drive home the message of rail safety.

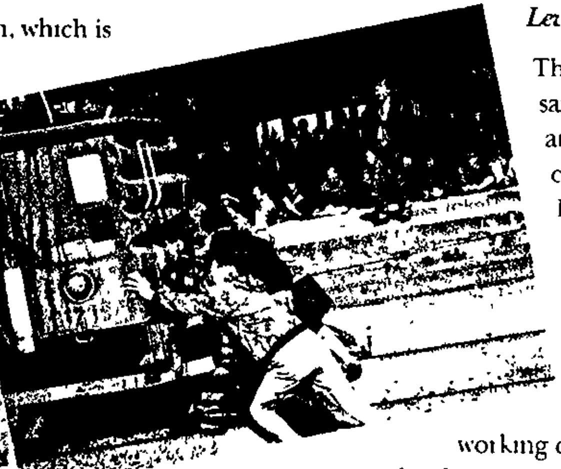
Organised by security managers Vic Hewson and Rex Polglase, the demonstration was part of a pilot scheme for a safety programme for school children.

"We've had a great response from teachers, pupils and local rail staff," says Vic "In fact, a number of staff have already expressed a real interest in running the courses themselves."

The demonstration, which is done in a strictly controlled environment, includes children trying to push and stop wagons to show how heavy they are having the children close their eyes and rolling a wagon past them to show how quiet shunted wagons can be and running a locomotive over pieces of wood

A team of security corporate communications and safety staff has been set up to co-ordinate the safety campaign in schools which should be ready by the beginning of the new school year in February





Level crossings

The team is also co-ordinating other safety awareness programmes, aimed particularly at level crossings, in conjunction with the Land Transport Safety Authority Transit New Zealand, which is in charge of roading, and the Road Transport Association which covers the nation's truckies

New Zealand Rail is also working closely with the police to give level crossings a higher profile in the Road Code and in their publicity and safe driving campaigns ■

Extract from New Zealand Rail's Expressions Magazine

Graphic display highlights rail safety

A car involved in a non-fatal level crossing accident at Runanga last June has become the centre-piece for a rail safety display launched just before Christmas.

Above, Operation RailSafe Co-ordinator Lorraine Tamanui (second left) and Executive Manager Quality and Safety Ray Ryan, (second right) join the team from Hutt who built the display (l to r) Brian Sullivan (standing), Nigel Bird, Kevin Watson and Terry Peake

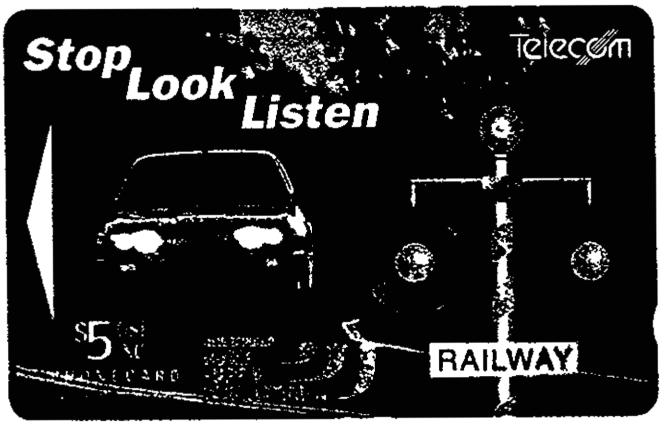
The display also has a range of posters, stories of rail accidents, and the effect on victims' families and New Zealand Rail staff, and a video on rail safety.

Organised by the Police, and sponsored by NZ Rail and Caltex, the display was put together by a team at Hutt Workshops.

Anyone interested in using the display for presentation purposes should get in touch with Inspector Dave Allo of Kapiti-Mana Police on (04) 237-2115

It has already attracted a great deal of attention when it was used by Taumarunui TXO Nigel Hearn at the local the A & P Show

NZ Rail's own rail safety campaign, Operation RailSafe, has now been presented to more than 30,000 children showing them the benefits of safety at level crossings and around railway tracks ■



FUN PAGE CROSSWORD

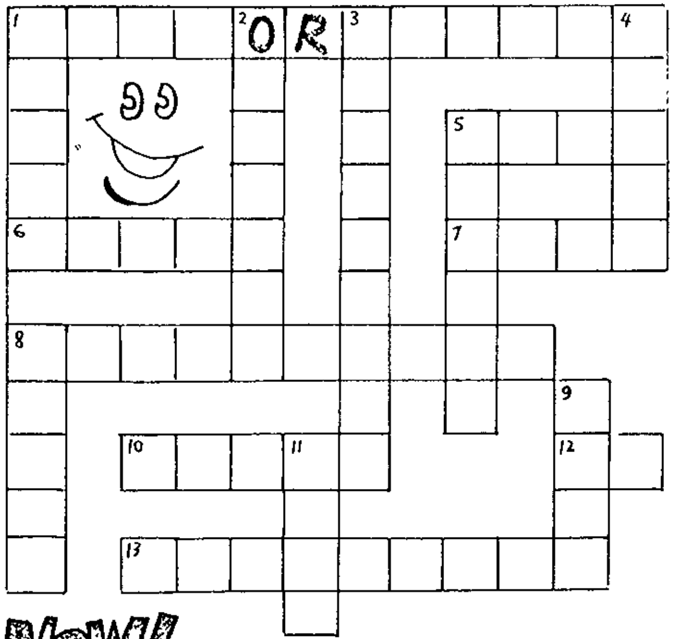
A PARENT CAN HELP!

Across

1+3 Kids get or around railway lines and yards
5 Trains take *ages to do this*
6 Play away from Rail lines and *these*
7 Be an extra pair of *these*
8 *It* weighs as much as a house
10 *It* weighs as much as a locomotive
12 Be a Back "See _ _" Driver
13 Mum and Dad should slow down at *these*

Down

1 Trains are very _ _ _ _ _
2 *It* plays dead
3 A Loco' can take *this far* to stop
4 Name for *idiots* who ride on platforms and around rail' yards
5 Trains can't do *this*
8 Kids can get hurt around *these* and yards
9 *Who* gets Hurt ?
11 Quiet (hissing noise)



NOW! WRITE A SHORT STORY ABOUT SAFETY CHOOSE ANY SUBJECT YOU LIKE - (REMEMBER, MUM OR DAD CAN HELP.)

POST THIS PAGE TO ▶ 'LORRAINE,' OPERATION RAILSAFE, NZ RAIL, PRIVATE BAG, WELLINGTON

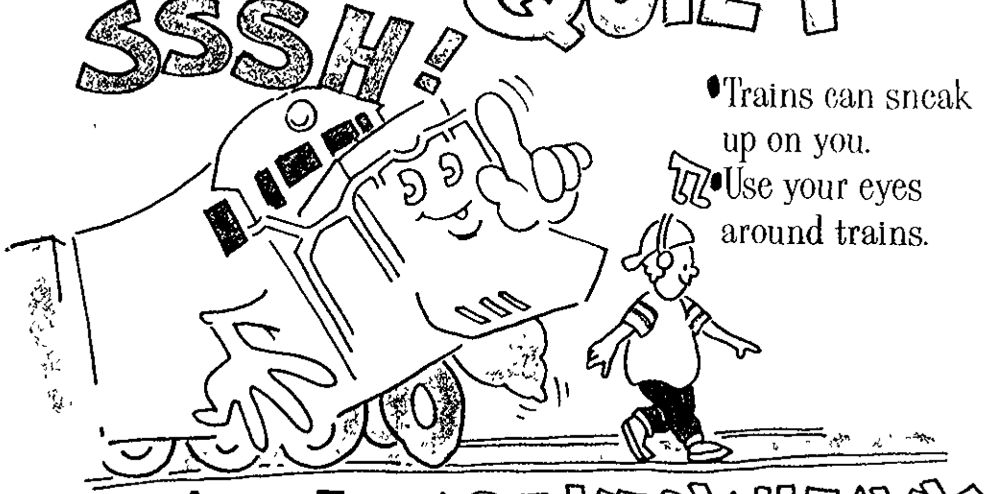
EVERY ENTRY WINS A RAILSAFE STICKER

PLEASE REMEMBER TO WRITE YOUR NAME AND ADDRESS

Operation Railsafe

New Zealand Rail

TRAINS ARE VERY QUIET

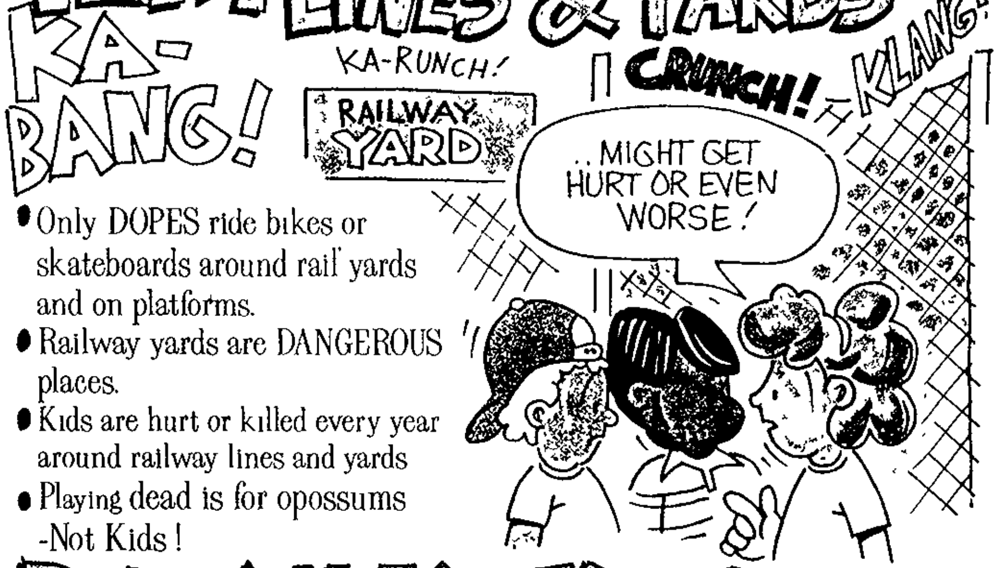


- Trains can sneak up on you.
- Use your eyes around trains.

TRAINS ARE VERY HEAVY & TAKE AGES TO STOP

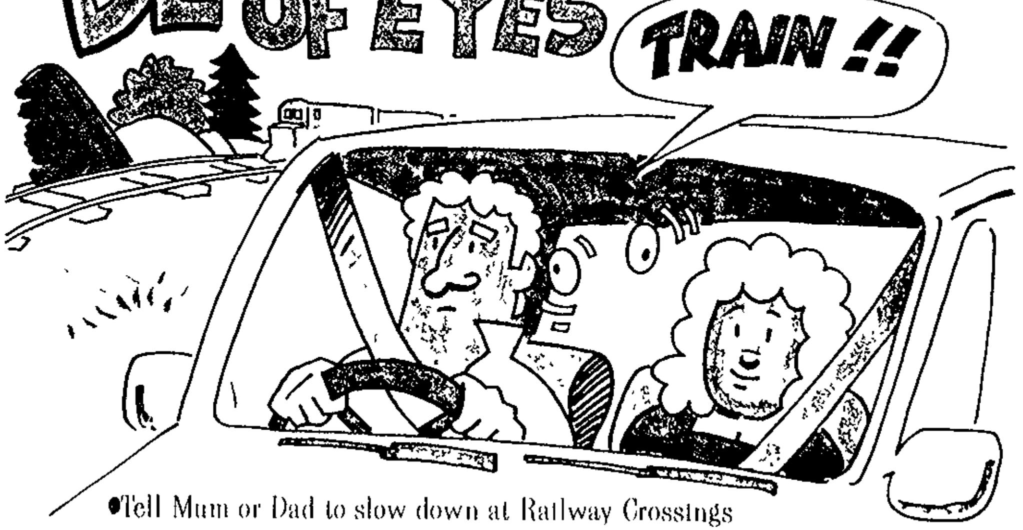
- A locomotive can weigh as much as a house
- Trains can take up to a kilometre to stop
- Trains CAN'T swerve to miss you

PLAY AWAY FROM RAIL LINES & YARDS



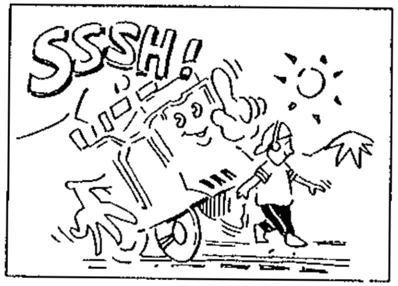
- Only DOPES ride bikes or skateboards around rail yards and on platforms.
- Railway yards are DANGEROUS places.
- Kids are hurt or killed every year around railway lines and yards
- Playing dead is for opossums -Not Kids!

BE AN EXTRA PAIR OF EYES



- Tell Mum or Dad to slow down at Railway Crossings

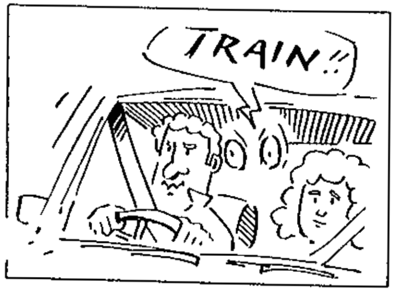
—BE a back "See-IT" driver.



Trains are very quiet

Trains are very heavy and take ages to stop

Don't play near trains, tracks or yards



Be a 'Back See - It Driver'

Operation Railsafe

This is to certify that

---

has attended
'Operation Railsafe'
and understands fully why
it is so important
to be very careful around
Trains, Tracks and Yards.

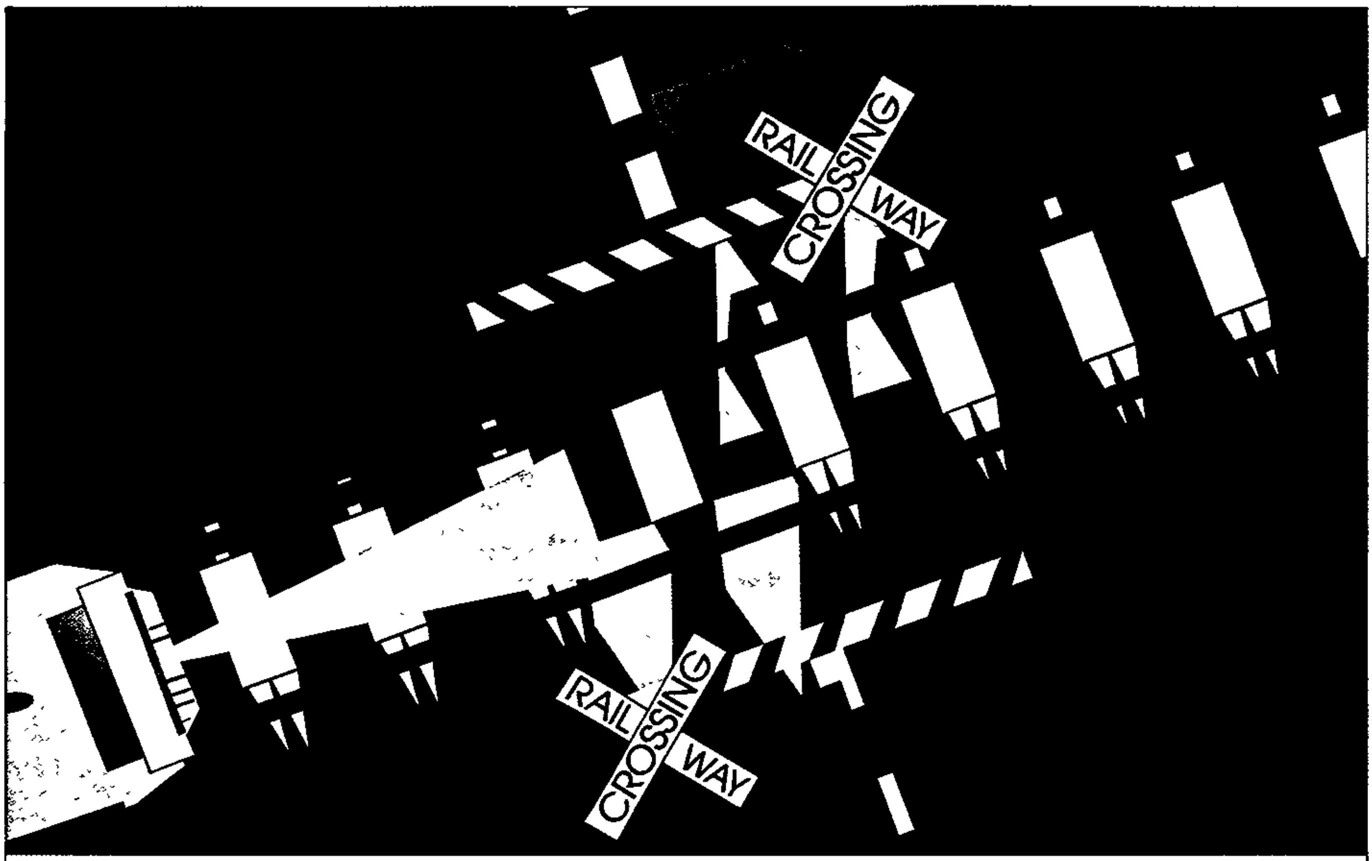
Co-ordinator "Operation Railsafe

Date

SECURITYEXPRESS

ISSUE 5 NOVEMBER 1993 New Zealand Rail

SAFETY AWARENESS CAMPAIGN

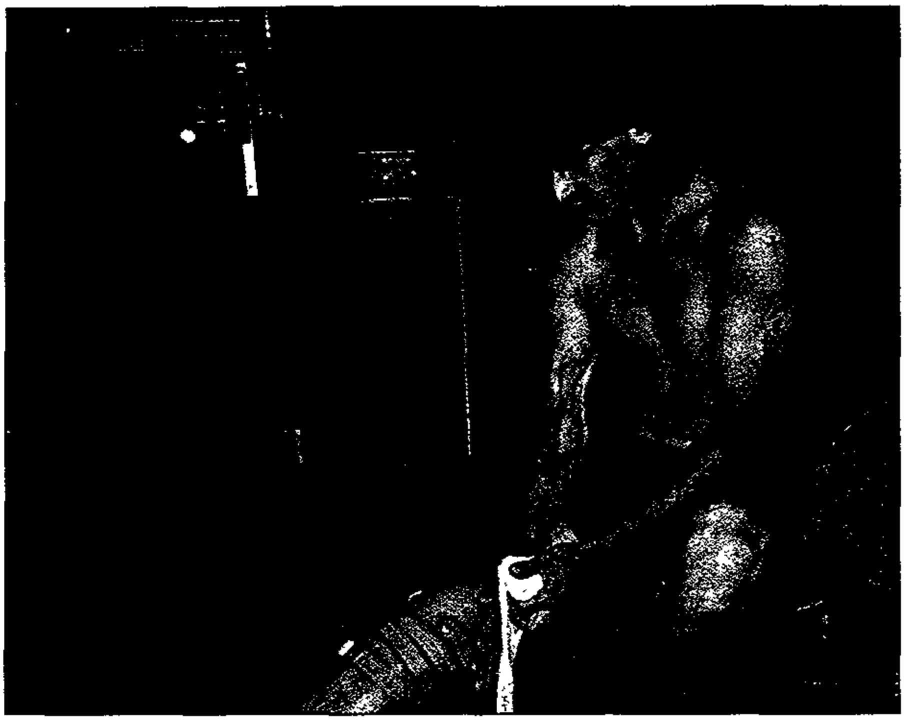


Don't become a Sleeper ! Train Your Mind to Mind the Train

Read this Issue of Security Express to find out:

- the story of a young man whose dreams have been destroyed by playing 'chicken' with a train!
- the winning **Safety Slogan** and who wrote it!
- the current "count" in our battle against the people who insist on ignoring the level crossing alarms!
- the number of **"Lowlife"** we have identified this year !
- Security News in brief!
- details of the exclusive **"Tarpaulin Spotting Club"**

LOCO ON THE LINE.



• • • • • • • • • • • • • • • • •

This issue of Security Express continues the Company's emphasis on Safety around Railway Tracks. In Dunedin a young man called Jason Percy who was seriously injured in a train accident seven years ago contacted the local Manager, Peter Hansen, and offered to help spread the safety message. Loco has made contact with Jason and this is his story:

• • • • • • • • • • • • • • • • •

Jason: Seven years ago, when I was 15, and a student at Otago Boys High School I was seriously injured by a train. Two friends and I had got into playing chicken with the trains at Port Chalmers at the level crossing above Iona Church. For nearly four months we had sat by the tracks at various times and just watched the trains come and go. We worked out speeds and decided which trains were slower than others. Then we started playing chicken.

***Loco:* So you're saying that you actually spent time planning how to play chicken.**

Jason: Yes we did and the idea was to stand in front of the train and see who could stay there the longest before jumping away.

***Loco:* Did you all do it together?**

Jason: No, we had turns. The two who weren't playing chicken might run along and jump on a flat deck and watch from there.

***Loco:* How often did you do it?**

Jason: Probably 15 times at least. We did it nearly every day, five days a week for several weeks.

***Loco:* Why would you want to do something like that?**

Jason: Down in Port Chalmers it was pretty boring and we thought it was cool. I got a real buzz - from the adrenaline I suppose. We had been warned by the Police but never took any notice.

***Loco:* What happened when you got injured.**

Jason: It was my turn to stand and play chicken. I think I had had a couple of drinks that day. My reflexes were too slow and I didn't make it. I can remember getting pushed along in front of the train for what seemed like a long way and next thing I knew I was on the side of the track. I looked at my right arm. It was barely hanging on and I could see everything working inside the arm. My back was all grazed, the back of my head was split open and my right leg was also badly injured My mates freaked out. One of them half carried me along the track and the other one ran home to my parents. The Ambulance and the Police came and I was taken to hospital.

***Loco:* How are you now?**

Jason: I've lost 70% of the muscle on my arm. It pretty much just hangs there now. The fingers on that hand don't work properly and I can't even hold a glass of water. I can walk - almost normally but not up hills or for any distance. After 2 or 3 minutes I get tired. My hip was crushed and I now have a plastic hip.

***Loco:* What do you do with your time now?**

Jason: I'm a volunteer worker at the Hospice - I help out in the kitchen. Working there makes me realise that I'm lucky compared to some other people.

***Loco*: What do you think now when you look back?**

Jason: I feel a right idiot. I've stuffed my career - I was planning to be a Gunner in the Army but I can't get in in my condition. I am now totally scared of trains - won't even go near them. Also I'm afraid I may have screwed up a train driver's life. I feel sorry for the train driver.

***Loco:* What would you say to others?**

Jason: I'm passionate about wanting to warn others about the dangers of playing around trains. You have a life to live. Don't throw it away in 10 seconds.

***Loco:* I would like to thank you, Jason, for coming forward and being prepared to help. It can't have been easy for you.**

Note: Jason is going to help with the NZ Rail Safety Education programme in the Dunedin schools. He is sure to have an impact.

TARPAULIN SPOTTING
- JOIN THE CLUB -

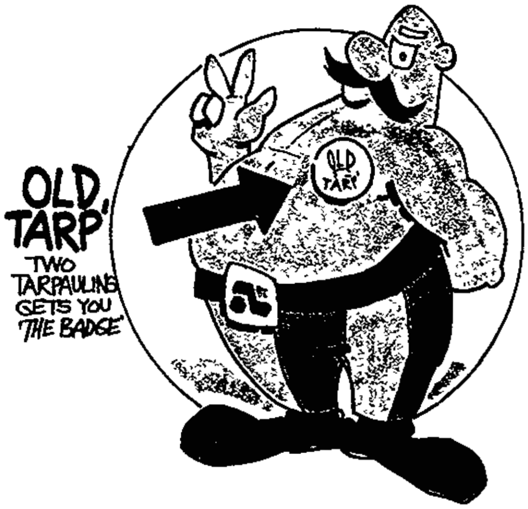
Always wanted to join an exclusive club? Well here's your chance. You can join the Tarpaulin Spotting Club and earn the respect and envy of all your workmates. All you have to do is spot two railway tarpaulins and when they are recovered you gain entry to the Club.

Two tarpaulins gives you the title of **"Old Tarp"** and you will be issued with the honourary badge showing this title. Wear it with pride.

Five tarpaulins makes you a **"Clever Old Tarp"** and you will be issued with a badge and the Cap of Office displaying that title.

Ten tarpaulins and you become a **"Grand Old Tarp"**. You are given a badge, a cap bearing that distinguished title and are awarded in addition with the "Grand Old Tarp" braces. A very significant honour.

Applications for entry to this Elite Club must be made to "Loco" or the Corporate Security Manager, extension 48837.



LOCO SAYS -"KEEP YOUR EYES OPEN"

"LOCO" REPORTS ....

SAFETY AWARENESS

SAFETY SLOGAN COMPETITION

The popularity of the Slogan Competition shows just how concerned Rail Staff are about Safety. We had over 165 slogans entered and they were very good. Francis Small and I had a difficult job picking out the best one but finally decided on

……………………………

"Train your mind to mind the Train."

……………………………

We picked this one for several reasons. It gives a positive message rather than saying "Don't do something." Also it emphasises training and education. Finally it is suitable for both adults and children. Chris Stedman from Railtechnology in Wellington was the successful writer and will be getting his prize in the near future.

LEVEL CROSSING INCIDENTS

The number of near misses and accidents at level crossings continues to be a problem. Its unbelievable the risks that some people seem to be prepared to take and the danger they put other people in. We are firmly convinced that the long term key is education and awareness but this has to be backed up by an uncompromising attitude from us in respect of offenses.

Rex (that Security Guy that works almost as hard as me) is taking a special interest in level crossing incidents and wants all staff who see an accident or near miss to contact him. One of the things that Rex does is follow up all of them with the Police to make sure that the Police investigate and prosecute.

Rex doesn't often get angry but boy, was he upset with a Police Officer the other day when an offender was only charged with failing to stop for a red light. I'm sure the Officer's name wasn't dork and I think Rex must have got mixed up with someone else he knew.

Things should improve now though because Rex has had a meeting with Assistant Commissioner Phil Wright and got a very helpful and positive response. The Police have agreed to issue a policy note nationally to all staff encouraging them to use more serious charges for level crossing incidents.

At the moment Rex has thirty level crossing incidents on his books. The results so far are:

	Prosecutions:
Interfering with transport (Crimes Act - very serious)	1
Careless/Dangerous Driving	10
Failing to Stop for a Red Light (Minor Offense!)	3
Police Warning	2
Wrong reg. no. taken	2
Civil Matter	1
Still under investigation	10
No Police action taken	2

Rex knows that staff who report these incidents have a keen interest in finding out the results and whenever possible tries to let people know the outcome. Loco Engineers, ensure your name goes on the incident advice so that Rex can contact you

LOWLIFE COUNT !!!

At the time of going to print the Lowlife count stood at 171! This represents 171 people who have been identified for some form of offending against New Zealand Rail. Twelve of these were staff (note the were) and the rest came from the public. We have got most of these because Railway Staff are getting angry about lowlife who steal our property and ultimately threaten our jobs.

LOCO FUND

The "Economic Recovery" has hit the Loco Fund. we now have over $2,500.00. We have had donations from the Linwood Loco Social Club, the Waterfront Gallery (300 chocolate peanut slabs, 8 crystal glasses & a mantel clock) and people like Osca Winner, Nigel Mullis who donated a watch that had been presented to him as part of a Quality Award. I mentioned in the last Security Express that this is all going to Intellectually Handicapped Children's' Christmas Party in Christchurch. I would like to thank all the people who have helped raise the money this year. It's neat to get support like this .

Regards Loco

International Rail
Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9529

Bill Casley

Certification of Railway Safety workers under the New South Wales Rail Safety Act

Publisher
2000 International Rail Safety Conference

V/10 W.S. Casley

Certification of Railway Safety Workers under the New South Wales Rail Safety Act

NEW SOUTH WALES **DEPARTMENT OF TRANSPORT**

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INTERNATIONAL RAILWAY SAFETY SEMINAR

MAINZ, 1995

CERTIFICATION OF RAILWAY SAFETY WORKERS UNDER THE NEW SOUTH WALES RAIL SAFETY ACT

W. S. Casley
Executive Director
Transport Safety Bureau

CERTIFICATION OF RAILWAY SAFETY WORKERS

UNDER THE NEW SOUTH WALES RAIL SAFETY ACT

1. Introduction

The Rail Safety Act, 1993 introduced a number of new mechanisms to regulate rail safety in New South Wales (NSW).

Unlike earlier rail safety systems, these regulatory mechanisms are independent of the state owned railway, the State Rail Authority (SRA). They cover not only the SRA but also all other railway owners and operators in the state of NSW.

They were introduced because of substantial changes in the NSW rail industry, including the establishment of the National Rail Corporation, the growing trend to establish commercial short lines on previously disused SRA lines, the introduction of light rail rapid transit systems and the likely introduction within NSW of private sector high-speed rail services.

Amongst the significant features of the NSW Rail Safety Act is the requirement for an owner or operator of a railway to ensure that persons they have employed or entered into a contract with to perform railway safety work, are adequately trained, have the necessary health and fitness to undertake the work and are in receipt of appropriate certificates of competency.

For its purposes, the Act defines an owner of a railway as the person responsible for the construction and/or maintenance of the railway's infrastructure, whereas an operator is a person who is responsible for operating the rolling stock on a railway.

The purpose of the certification is to attest that:

- the person certified is considered to be of good health and fitness and in all other respects to be a fit and proper person to perform railway safety work; and

- the person certified is considered to have sufficient responsibility and aptitude to perform the railway safety work to which the certification relates, in accordance with the standards submitted by the accredited owner or operator of the railway on which the railway safety work is to be performed, and accepted by the Director-General.

The object of this paper is to describe the relevant features regarding the process of issuing certificates of competency to railway safety workers. Certificates may be issued by the NSW Department of Transport or its authorised agent.

2. Railway safety work

The Act defines railway safety work as any of the following classes of work carried out by a railway employee:

- work as a driver, guard, observer or engineman on a train;
- work at a railway station or other place as a station-master, operator of train signals or shunter of trains or work which otherwise relates to the movement of trains;
- work on or about railway infrastructure relating to the repair, maintenance or upgrading of railway tracks or any rolling stock or associated works or equipment; and
- any other work that is prescribed by the regulations as railway safety work;

but does not include any work that involves the driving of a motor vehicle on a public street.

3. Eligibility criteria for railway safety workers

To be eligible for a railway safety worker position a person, must be:

- of a requisite level of competency;
- qualified to perform the railway safety work of the position;
- where necessary, qualified in the system(s) of safeworking and/or safeworking procedures required for the position; and
- considered to be of good health and fitness, and in all other respects to be a fit and proper person, in accordance with the appropriate accreditation conditions of the respective accredited owner and/or operator by whom the person is engaged to conduct railway safety work.

4. Pre-requisites for appointment as railway safety workers

Owners and operators are required to establish approved pre-requisites for persons to be appointed to railway safety worker positions, to ensure that they have the appropriate training and experience which will allow them to perform their duties in a safe and responsible manner. Approval for these pre-requisites will be granted by the Department.

Such pre-requisites shall include health criteria, work experience criteria, training schedules and, where necessary, safeworking qualifications to ensure the persons are properly equipped to assume the responsibilities of the railway safety worker position. Additionally, for staff engaged in the operation of various classes of locomotives and/or self propelled passenger rolling stock the prerequisites shall also include line knowledge and driving skill aspects.

5. Competency

Persons required to perform railway safety work, in addition to the pre-requisite training necessary to perform the position, are to be given prescribed theoretical and on-the-job training to familiarise them with the local conditions and work practices. This training is to be provided by a person, the "trainer" who has a certification for that position.

Upon completion of the prescribed on-the-job training, the trainer must be satisfied the person is competent to perform the duties associated with the railway safety worker position. The trainee must also be confident of being able to perform the duties of the position. When both these conditions have been met, the person may then be considered competent to perform the duties without supervision, if required.

The trainer must forward written confirmation to the Department or its authorised agent certifying that the person is competent to perform the duties of the railway safety worker position.

6. Issue of certificate of competency

There is no barrier to the Department or its authorised agent issuing a certificate of competency based on advice provided to it by another accredited railway indicating that an applicant has satisfied the prerequisites for the particular certification involved. However, in these circumstances, the persons providing advice to the Department or its authorised agent must be persons which have been accepted by the Department as capable of providing such advice.

Certificates of competency, issued by an authorised agent, shall only be issued by designated officers of the authorised agent and shall only be issued upon confirmation by the designated officer that all the eligibility requirements and prerequisites for the position have been met by the person seeking certification.

In accordance with the requirements of Section 32 (2) of the Rail Safety Act, the Director-General of the Department of Transport retains the right to final determination as to whether a designated officer possesses sufficient experience and expertise concerning safeworking systems and railway safety work to justify appointment.

7. Validity

Certificates of competency generally will remain valid for a period not exceeding two years. The validity of specified certificates may remain valid for an extended period provided a general approval is sought from, and granted by, the Director-General.

For certificates of competency to be valid they must:

- be of an approved format;
- be signed by a designated issuing person;
- be signed by the person to whom the certificate is issued;
- indicate the expiry date; and
- indicate any restrictions applicable.

8. Re-certification

Upon the expiration of the validity period of a certificate of competency, the person must attend an approved refresher course and be re-certified in the prerequisite qualifications of the position by achieving the prescribed pass mark of the refresher course.

New certificates of competency shall only be issued upon confirmation that all the eligibility requirements for renewal have been met by the person seeking certification.

9. Issue of advice

Specific advice must be forwarded to the Department, as soon as practical, but no later than one month after the date of issue, showing the detail of to whom and for what purpose the certificate of competency has been issued. This detail shall include:

- applicant's full name;
- address (for communication purposes);
- certificate type and individual number;
- certificate expiry date;
- detail of any applicable restriction;
- detail of employer, and

shall be provided to the Department each time the relevant certification is issued. The format of such advice shall be in accordance with Department requirements.

10. Cancellation of certification advice

Whenever a certificate of competency is cancelled by an authorised agent the detail of such cancellation shall be notified in writing to the Department as soon as practical, but no later than one week after the date of withdrawal.

11. Security

The authorised agent must at all times ensure that the integrity and security of the process of issuing certificates of competency is maintained.

This shall be achieved by instituting and maintaining adequate security procedures for the management of the process of issuing certificates of competency.

Such security procedures shall include, but be not necessarily restricted to, ensuring that:

- blank certificates are kept under proper security;
- persons receiving the certificate are in fact the person eligible for receiving the certification;
- all certificates of competency, prior to issue, shall be enclosed by an approved sealed plastic cover;
- issuing officers are not directly involved in competency assessments; and
- generally, theory trainers in theoretical training are not directly involved in practical competency assessment.

12. Train Driver Assessment Panel

All train crew engaged by an accredited operator to operate over an accredited owner's railway must be in possession of an appropriate certificate of competency relating to this arrangement.

A prerequisite for the issue of this certification shall be that the person shall be subjected to an assessment process to determine their suitability to effectively operate trains upon the accredited owner's railway.

The assessment shall be conducted by an appropriate assessment panel which shall evaluate each applicant's suitability in regard to the following criteria:

- medical fitness;
- driving skills;
- particular locomotive class skills;
- safeworking knowledge applicable to the accredited owner's line; and
- route knowledge of the accredited owner's line.

The assessment panel will consist of:

- a representative of the railway owner (chairperson);
- a representative of the railway operator; and

each member of the panel must possess the necessary expertise, competency and responsibility to make the required assessments.

Whilst it may be practical for the assessment panel to make a determination based on affidavits sworn under the Act, this does not preclude the assessment panel from conducting practical testing to determine the suitability of an applicant.

Following a determination that the applicant is suitable to operate trains upon an accredited owner's railway, the assessment panel shall submit a recommendation to the Department for the issue of an appropriate certificate of competency.

13. Conclusion

Currently some 8,000 railway safety workers have been identified within NSW. It is envisaged that by March 1996 all of these persons will have been issued with appropriate certificates of competency.

Generally, the certificates relate to the following work activities:

- train crew
  (driver, second person, guard, etc.);
- train control staff
  (signallers, controllers, station masters, etc.);and
- track maintenance staff
  (worksite protectors, work site supervisors, etc.).

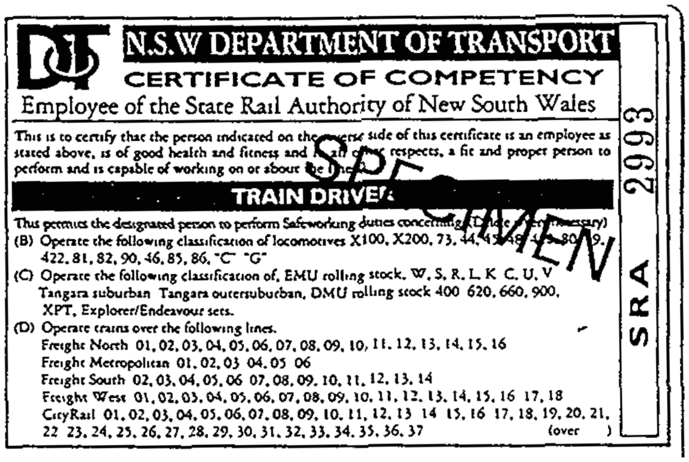
A representative sample of the style of certificated of competency is shown in Attachment 1.

oooOooo

ATTACHMENT 1

CERTIFICATION OF RAILWAY SAFETY WORKERS UNDER THE NEW SOUTH WALES RAIL SAFETY ACT

SAMPLE CERTIFICATES OF COMPETENCY



N.S.W DEPARTMENT OF TRANSPORT

CERTIFICATE OF COMPETENCY

Employee of the State Rail Authority of New South Wales

This is to certify that the person indicated on the reverse side of this certificate is an employee as stated above, is of good health and fitness and in all other respects, a fit and proper person to perform and is capable of working on or about the line(s).

TRAIN DRIVER

This permits the designated person to perform Safeworking duties concerning (Delete if unnecessary)

(B) Operate the following classification of locomotives X100, X200, 73, 44, 45, 48, [illegible] 80, [illegible]9. 422, 81, 82, 90, 46, 85, 86, "C" "G"

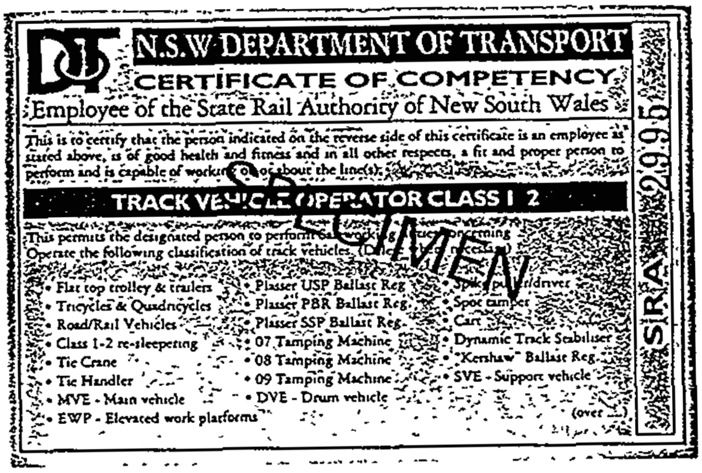
(C) Operate the following classification of, EMU rolling stock, W, S, R, L, K C, U, V Tangara suburban Tangara outersuburban, DMU rolling stock 400 620, 660, 900, XPT, Explorer/Endeavour sets.

(D) Operate trains over the following lines.

Freight North 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16
Freight Metropolitan 01, 02, 03 04, 05 06
Freight South 02, 03, 04, 05, 06 07, 08, 09, 10, 11, 12, 13, 14
Freight West 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16 17, 18
CityRail 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13 14 15, 16 17, 18, 19, 20, 21, 22 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37 (over)

SRA 2993

SPECIMEN



N.S.W DEPARTMENT OF TRANSPORT

CERTIFICATE OF COMPETENCY

Employee of the State Rail Authority of New South Wales

This is to certify that the person indicated on the reverse side of this certificate is an employee as stated above, is of good health and fitness and in all other respects, a fit and proper person to perform and is capable of working on or about the line(s).

TRACK VEHICLE OPERATOR CLASS 1 2

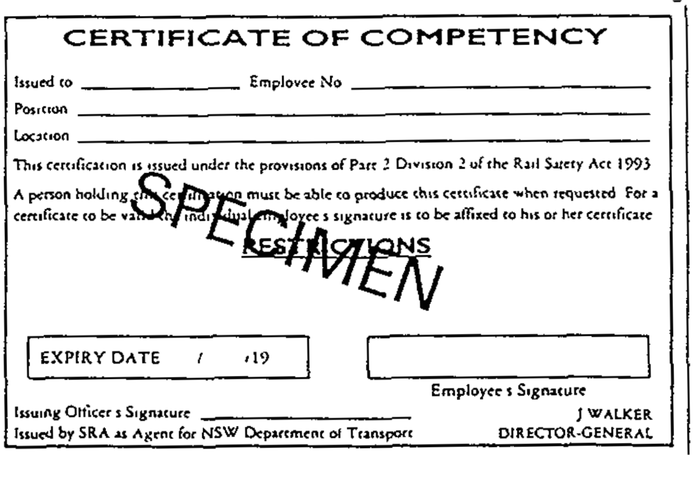
This permits the designated person to perform Safeworking duties concerning
Operate the following classification of track vehicles. (Delete [illegible] necessary)

- Flat top trolley & trailers
- Tricycles & Quadricycles
- Road/Rail Vehicles
- Class 1-2 re-sleepering
- Tie Crane
- Tie Handler
- MVE - Main vehicle
- EWP - Elevated work platforms
- Plasser USP Ballast Reg
- Plasser PBR Ballast Reg.
- Plasser SSP Ballast Reg.
- 07 Tamping Machine
- 08 Tamping Machine
- 09 Tamping Machine
- DVE - Drum vehicle
- Spike puller/driver
- Spot tamper
- Cart
- Dynamic Track Stabiliser
- "Kershaw" Ballast Reg.
- SVE - Support vehicle

(over)

SRA 2995

SPECIMEN



CERTIFICATE OF COMPETENCY

Issued to ______________ Employee No ______________
Position ______________
Location ______________

This certification is issued under the provisions of Part 2 Division 2 of the Rail Safety Act 1993

A person holding this certification must be able to produce this certificate when requested For a certificate to be valid the individual employee s signature is to be affixed to his or her certificate

RESTRICTIONS

EXPIRY DATE / /19

Employee s Signature

Issuing Officer s Signature ______________
Issued by SRA as Agent for NSW Department of Transport

J WALKER
DIRECTOR-GENERAL

SPECIMEN

International Rail Safety Conference

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

Paper 9530

Bill Casley

The Regulation of Railways under the New South Wales Rail Safety Act

Publisher
2000 International Rail Safety Conference

V/11 W.S. Casly

The Regulation of Railways under the New South Wales Rail Safety Act

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INTERNATIONAL RAILWAY SAFETY SEMINAR

MAINZ, 1995

THE REGULATION OF RAILWAYS UNDER THE NEW SOUTH WALES RAIL SAFETY ACT

AN OVERVIEW

W. S. Casley
Executive Director
Transport Safety Bureau

NEW SOUTH WALES

RAIL SAFETY REGULATION

1. Introduction

It is a matter of public record that the New South Wales Rail Safety Act was passed with bi-partisan support in September 1993. This clearly provided the necessary foundation for the development and implementation of a credible and practical regulatory process covering the operations of railways in NSW under the auspices of a Directorate of Rail Safety within the NSW Department of Transport.

Moreover, since September 1993 the legislation has steered a process of change in the nature of railway regulation, not only in NSW, but in the Australasian region as a whole.

The NSW legislation has formed the backbone of a model which has been used by the Australian Commonwealth Government and the various state Governments as the basis for a mutual recognition system which enables accredited railway operators to cross state borders within Australia with a minimum of bureaucratic interference. It has also provided a benchmark for the development of an Australian Standard for rail safety management.

The achievements to date regarding safety regulation in NSW have been most encouraging and following a recommendation by the Minister for Transport, Mr Brian Langton, the Premier of NSW, Mr Bob Carr, announced on 18 July 1995 the establishment of the Transport Safety Bureau within the Department of Transport as a further step in the continuing process of improving transport safety in NSW.

The functions previously carried out by the Directorate of Rail Safety regarding rail safety regulation are now incorporated within the Bureau's sphere of activity, which encompasses all public transport services operating in NSW. The Bureau's principal goal is to increase the safety of public transport users through the development and monitoring of safety performance standards for the operation of public transport services and the security of passengers. To this end, the Bureau consults with the rail, taxi and bus operators to increase inter-modal co-ordination and so facilitate safer passenger journeys.

The purpose of this paper is to provide an overview of railway regulation within NSW under the provisions of the NSW Rail Safety Act. In this regard, the paper provides concise comment on the various aspects of rail safety regulation within NSW. However, any readers who wish to have a precise knowledge of the legislation are advised to familiarise themselves with the Rail Safety Act itself.

2. NSW Rail Safety Act

The object of this Act is to promote the safe construction, operation and maintenance of railways within NSW by providing for:

- the accreditation of the owners and operators of railways;
- the certification of the competency of railway employees who perform railway safety work;
- the monitoring of the safety performance of railways;
- regular safety compliance inspections;
- analysis of occurrence trends in accidents or other incidents; and
- implementing measures aimed at securing rail safety.

For its purposes, the Act defines an owner of a railway as the person responsible for the construction and/or maintenance of the railway's infrastructure, whereas an operator is a person who is responsible for operating the rolling stock on a railway.

3. Accreditation

The Director-General of the Department of Transport is responsible for accrediting railway operations in NSW under the auspices of the Transport Safety Bureau. The process of accreditation is used to demonstrate that an applicant for accreditation is a person who is of good repute and in all other respect is fit and proper to be responsible for the operation, construction or maintenance of a railway, its infrastructure and its rolling stock.

In particular an applicant has to satisfactorily demonstrate that he/she possesses the competency and capacity to meet the standards submitted for the purposes of the safe construction, operation and maintenance of the railway, relating to the following:

- financial viability;
- managerial and technical competency;
- suitability of rolling stock;
- appropriateness of safeworking systems;
- availability and competency of railway employees;
- availability and adequacy of infrastructure generally and, in particular, track, associated track structures, signalling systems and other relevant facilities; and
- public risk insurance.

Additionally, applicants are required to provide a comprehensive safety management plan which identifies any significant potential risks regarding the railway's construction, maintenance or operation; and the systems, audits, expertise and resources that are to be used to address these risks.

In practical terms, it is the applicant's responsibility to demonstrate that the organisation has the capacity and competency to safely maintain and operate the railway.

It should be clearly understood that each applicant for accreditation is primarily responsible for providing sufficient detail to enable an effective determination of their capability to safely maintain and operate a railway system.

As part of its assessment of an application, the Transport Safety Bureau conducts inspections of infrastructure, rolling stock and operational aspects for compliance. Additionally, the Director-General of the Department may, at any time, depending on the scope of the proposal, vary the requirements for information that must be supplied in relation to an application for accreditation.

4. Notice of Accreditation

Following an applicant's successful demonstration of compliance with the prescribed accreditation requirements, the Director-General may grant in writing an "accreditation to operate". Accreditations may be subject to such conditions and restrictions (if any) as are specified by the Director-General and are described in detail in the Notice of Accreditation and its respective annexures which accompany the Director-General's written advice. In addition to the conditions and restrictions specified by the Director-General, the notice of accreditation also contains detail of the standards submitted by the applicant and accepted by the Director-General.

Generally the notice of accreditation describes:

- the railway upon which the accredited owner or operator has been permitted to operate;
- the systems, audits, expertise and resources which the accredited owner or operator shall employ to address risk upon its railway;
- the nominated rolling stock that the operator is accredited to operate together with any specific conditions which apply to that rolling stock;
- the various systems and procedures which the owner or operator shall use for the safe operation of the railway;
- the various standards, methods and procedures which an owner shall use for the safe construction, inspection and maintenance of the infrastructure of the railway under all conditions;

- the various standards, methods and procedures which an operator shall use for the safe construction, inspection and maintenance of the rolling stock of the railway under all conditions;
- the various standards, methods and procedures an owner or operator shall use in respect of the training, health and fitness of all persons required to carry out railway safety work in terms of the Rail Safety Act whether they be volunteers, employees or contractors;

Having obtained accreditation, the principal obligation of a railway owner or operator to maintain and operate the railway safely and in accordance with the terms of the accreditation as well as co-operating fully with the Transport Safety Bureau in relation to all aspects of rail safety.

5. Exemption of Owners of Private Sidings from Accreditation

The legislation provides that a person who owns a private siding is not required to be accredited under the Act. However, if a person wishes a private siding to continue to be connected, or have access to, a railway, then they will need to register the siding with the Department.

Where a private siding has not been registered, then the owner of a railway may apply for permission to disconnect the siding from the line.

Only accredited operators will be permitted to operate on any siding.

6. Sale or Transfer of railway by accredited person

An accredited railway represents a valuable asset due to the fact that the accreditation process adds quantifiable value to the asset.

Should an entrepreneur develop a railway from a non-accredited status to accreditation under the NSW legislation adequate provision has been made to enable this valuable asset to be transferred on the open market with a minimum of impediment to the commercial process.

The legislation provides for an accredited railway to be sold subject to conditions and restrictions (if any) fixed by the Department. Generally these would relate to financial capacity and managerial competency of the new owners.

7. Amendment, Variation or Suspension of Accreditation

An accredited person who proposes to construct new track or infrastructure or new rolling stock must apply to the Department before taking the action proposed.

If the Director-General considers there is an immediate threat to the safety of the public, he/she may suspend an accreditation for a period of up to 28 days.

Prior to the Director-General amending, varying, suspending or cancelling the credentials of an accredited person, the Director-General shall give the person reasonable notice after having taken into consideration the standards submitted by the accredited person at the time of the original application.

An accredited person may make representations concerning the proposed amendment, variation, suspension or cancellation of its accreditation. The Director General is required to consider any such representations prior to determining whether to amend, vary, suspend or cancel the credentials.

A person aggrieved by a decision of the Director-General may appeal against the decision to the Supreme Court.

8. Annual Fees

An accredited person under the Rail Safety Act is required to pay the annual fees set by the Minister for Transport.

In setting the annual fees for accreditation, the legislation provides that the Minister may fix fees on one or more of the following:

- rate per tonne of freight or passengers carried;
- rate per kilometre of track;
- rate per unit of rolling stock; and
- a person's capacity to pay.

9. Certificates of Competency

Owners or operators who employ persons to perform railway safety work are required to ensure the person is the holder of an appropriate Certificate of Competency. The purpose of certification is to attest that the person certified is considered to be of good health and fitness and in all other respects a fit and proper person to perform railway safety work; and have sufficient responsibility and aptitude to perform the railway safety work.

The certification is given in writing by the Department or its authorised agent.

10. Safety Compliance Inspections

The legislation provides that Director-General must, at intervals that he considers to be appropriate (but no less frequently than once every 12 months), conduct safety compliance inspection to ensure that an accredited person is complying with the terms of his/her accreditation. Generally this inspection relates to:

- the railway track, other infrastructure and rolling stock of an accredited person;
- the construction, operation and maintenance of the railway of an accredited person; and
- the performance of the railway employees of the accredited person.

The Department may inspect any documents that are held by, or that are under the control of, an accredited person relating to:

- the construction, operation or maintenance of railways by the accredited person; or
- the acquisition, disposal, renovation or repair of track, other infrastructure or rolling stock; or
- the preparation and implementation of the safeworking systems of a railway; or
- any other matters the Director-General considers to be relevant to the safe construction, operation or maintenance of railways by the accredited person.

11. Directions to undertake remedial safety work

Should the result of a safety compliance inspection identify serious shortcomings in compliance with the terms of the person's accreditation, the Director-General may direct the person to undertake remedial safety work to secure compliance. Where it is necessary for such a direction then it shall be given by written notice that sets out details of the work to be undertaken and the period within which it is to be undertaken.

If an accredited person fails to comply with the direction, the Director-General may arrange for the work to be undertaken on behalf of the person and may recover from the person all costs and expenses of and associated with the undertaking of the work. The Director-General may only arrange for the work to be undertaken if the cost of the work is likely to be less than $100,000 or such other amount as is specified for the purpose as a condition of the person's accreditation.

The Director-General may also direct an accredited person to provide a program for, and a timetable for completion of, remedial safety work that the person proposes to undertake to remedy a failure to comply with the requirements of the Act or the terms of the person's accreditation. This direction is to be given by written notice and is to state the date by which the program is to be provided.

12. Safety Reports

Accredited persons must submit annual safety reports dealing with the general conduct of their railway operations and any significant developments relating to those operations to the Department within 28 days before each anniversary of their accreditation.

13. Notifiable Occurrences

Accredited persons must report to the Department any notifiable occurrence that occurs on a railway owned or operated by them and that is of a kind that is specified in Schedule 1 of the Rail Safety Act.

Generally these notifiable occurrences relate to death or injury to persons, derailment, collisions or other significant incidents affecting the safe operation of a railway. Attachment 1 provides a detailed list of the notifiable occurrences.

Notifiable occurrences are to be reported within defined times. Generally these times are defined as requiring notification as soon as is practical after the occurrence but, in any event, no later than 72 hours after the occurrence occurs.

14. Inquiries into railway accidents and incidents

The legislation recognises the importance of railway conducting their own inquiries into any railway accident or incident that may affect the safe construction, operation or maintenance of the railway.

Having conducted the inquiry, the accredited person is obliged to forward a detailed report to the Department for review.

Inquiries by accredited persons are to be conducted in an approved manner and within the time specified by the Director-General.

In addition to the accredited person conducting its own inquiry, the Minister may require the Director-General or a nominated person to inquire into and report to him on any railway accident or incident. This provision is likely only to be applied in the case of a serious accident or incident which has high Public Interest in the matter and thereby require independence from the accredited railway(s) involved.

15. Railway Safety Workers

It is a condition of accreditation that an accredited person must ensure that all railway employees employed, or contracted, by the person to perform railway safety work are adequately trained to perform the functions for which they are certified. Additionally, the accredited person must ensure that all railway employees employed, or contracted, by the person to perform railway safety work are of sufficient good health and fitness to perform the functions for which they are certified.

16. Alcohol or Other Drugs

Persons employed, or contracted, by an accredited person to perform railway safety work are not to be under the influence of alcohol or other drugs when about to carry out, or while carrying out, railway safety work. The Director-General may at any time arrange with accredited persons for the random testing of any person carrying out railway safety work on the railway for the presence of alcohol or any other drug to ensure that accredited persons are complying with the terms of their accreditation.

17. Closure of Level-Crossings

The Director-General may direct an accredited person to close any level-crossing, bridge or other structure for crossing or passing over or under a railway if the Director-General considers that it is necessary to do so for the safe operation of the railway.

Where an accredited person is served with a direction from the Director-General regarding the closure of a level crossing or other structure the person shall:

- cause a notice of the proposed closure to be published in a local newspaper circulating in the area in which the level-crossing, bridge or other structure is situated; and

- notify the Roads and Traffic Authority and the council of the area concerned of the proposed closure.

On the closure of any such level crossing, bridge or other structure, all rights, easements and privileges in relation to that crossing, bridge or other structure are extinguished.

18. Offences under the Rail Safety Act

If a person contravenes a provision of the Rail Safety Act, such a person is punishable by a range of penalties ranging from the maximum of 2,500 penalty points (currently $250,000) for wrongfully obtaining or fraudulently altering credentials to 5 penalty points (currently $5) for the offence of failing to provide identification.

The following are examples of the range of offences provided for under the Act:

- Any person who by false statement or misrepresentation, obtains or attempts to obtain accreditation, or forges or fraudulently alters or uses an accreditation or allows an accreditation to be used by another person, is guilty of an offence. Maximum penalty 2,500 penalty points in the case of a corporation or in any other case, 1,000 penalty points or imprisonment for 12 months, or both.
- A person who contravenes or fails to comply with a condition or restriction attached to an accreditation is guilty of an offence. Maximum penalty 200 penalty points.
- A person who fails to install and maintain safety systems, devices or appliances in accordance with the person's accreditation is guilty of an offence. Maximum penalty 100 penalty points.
- A person who tampers with safety equipment or an interlocking system is guilty of an offence. Maximum penalty 100 penalty points.
- A person who hinders or obstructs an authorised officer in the execution of his or her duty is guilty of an offence. Maximum penalty 50 penalty points.
- A person who is not an accredited operator must not move a train to or from a private siding. Maximum penalty 20 penalty points.
- A person reasonably suspected to be committing or having committed an offence against the Rail Safety Act may be required to state their name and address. A person so refusing is guilty of an offence. Maximum penalty 5 penalty points.

19. Proceedings under the Rail Safety Act

Proceedings for an offence against the Rail Safety Act or its regulations are to be disposed of in a summary manner before:

- a Local Court constituted by a magistrate sitting alone; or
- the Supreme Court in its summary jurisdiction.

The maximum pecuniary penalty that may be imposed by a Local Court in proceedings for an offence against this Act or the regulations is 200 penalty units.

Proceedings for an offence against the Rail Safety Act or the regulations may be taken within 2 years after the offence was committed despite anything in the NSW Justices Act 1902.

20. Authority to take Proceedings

Any legal proceedings for an offence against, or to recover any charge, fee or money due under, the Rail Safety Act may be taken only by the Director-General or by a person authorised by the Director-General for the purpose.

Proceedings for an offence against this Act are not to be instituted in the Supreme Court without the written consent of the Director-General or of such other officer of the Department as may be authorised by the Director-General for this purpose.

Proceedings against the Crown or a statutory body representing the Crown for an offence against the Rail Safety Act are not to be instituted without the written consent of the Minister for Transport.

21. Conclusion

There have been a number of significant benefits achieved since the Rail Safety Act was proclaimed in 1993. The primary benefit to the community is that there is now a clear focus in the rail industry on providing for the safety of all railway systems operating in NSW.

The future direction for railway safety regulation within NSW has been strengthened by the establishment of the Transport Safety Bureau. This is a major Government initiative to improve transport safety regulation in NSW. Not only will the Bureau be responsible for administering the regulation of railway safety within NSW, but it will also be responsible for overseeing the regulation of safety aspects associated with the operation of all public transport and rail freight services in NSW, from technical standards for equipment through to issues concerning passenger security.

The Bureau comprises a small unit with a core of highly competent staff in specialised fields, supported by external resources as required. The Bureau's key functions will be to:

- ensure the safety of public transport services in terms of both the technical safety of operations and personal security;
- consult with rail, taxi, ferry and bus (public and private) operators to increase inter-modal co-ordination to facilitate safer passenger journeys; and
- oversight promotional campaigns to educate public transport employees and passengers with regard to safety matters.

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ATTACHMENT 1

THE REGULATION OF RAILWAYS UNDER THE NEW SOUTH WALES RAIL SAFETY ACT

NOTIFICATION OF OCCURRENCES

EMERGENCY NOTIFICATION

In cases of:

DEATH OR SERIOUS INJURY TO A PERSON

MAJOR COLLISION (material damage $5000 or greater)
MAJOR DERAILMENT (material damage $10000 or greater)
AJOR FIRE (material damage $5000 or greater)

notify the DUTY OFFICER

AS SOON AS POSSIBLE

after the incident

on the dedicated pager number:

1 800 67 7766

(24 hours a day 7 days a week)

nd convey the following information:

1. The name of the railway, or railways involved.
2. The name of a contact officer who has full details of the incident and is preferably at the scene.
3. A phone number on which the contact officer may be immediately contacted.
4. Brief details of the incident, eg. passenger train derailed, number of fatalities/injuries etc.

Follow up written notification on the official NOTIFICATION OF OCCURRENCES FORM must be forwarded to the Department of Transport within 72 hours of the incident occurring (unless other arrangements have been made).

ALL OTHER INCIDENTS

Within 72 hours of an incident occurring, written notification must be forwarded to the Department of Transport on the official NOTIFICATION OF OCCURRENCES FORM *(unless other arrangements have been made).*

Notifiable occurrences are define in Schedule 1 of the Rail Safety Act 1993 and are briefly:

1. Death
2. Permanent incapacitating injury
3. Temporary incapacitating injury (> 3 days off)
4. Other occurrences involving persons
   eg Falls, strikes, assaults etc (see Act for detail)
5. Collisions from rolling stock irregularities
6. Collisions from track obstructions
7. Collisions from safeworking staff irregularities
8. Collisions from wrong side signals
9. Collisions at level crossings
10. Collisions from track irregularites
11. Collisions from track structure failure
12. Collisions from vehicle loading irregularities
13. Collisions after derailment
14. Derailments from rolling stock irregularities
15. Derailments from track obstruction
16. Derailments from safeworking staff irregularities
17. Derailments from wrong side signals
18. Derailments from track irregularities
19 Derailments from track structure failure
20. Derailments from vehicle loading problems
21. Derailments from excessive speed
22. Derailments from track geometry exceedence
23. Derailments from collisions
24. Derailments from signal irregularities
25. Fires
26. Explosions
27. Equipment failures
28. Accidental division of train
29. Rail fracture
30. Rail buckling
31. Failure of tunnels, bridges or elevated structures
32. Failure of signal structure etc
33 Trains & rail vehicles passing signals at stop

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Satoshi Nakai

Safety Equipment introduced in East Japan Railway Company

Publisher
2000 International Rail Safety Conference

VI/1 Satoshi Nakai

Safety Equipment introducing in East Japan Railway Company

INTERNATIONAL RAILWAY SAFETY SEMINAR

Mainz

October 9. - October 11. 1995

Safety Equipment introducing in East Japan Railway Company

Satoshi Nakai

Manager of Safety Measures Section
East Japan Railway Company

1. Introduction

JR East was inaugurated in 1987 after the Japanese National Railway was privatized and divided into six passenger railway and one freight companies. Eight years have passed since then and JR East is still concentrating on safety improvement because the company regards the provision of safe railway transportation as its main goal. The company's basic ways of thinking are as follows:

(1) To make better, more effective safety devices and to promote their systematization.
(2) To award employees who deal with safety problems freely and voluntarily.
(3) To carry on the systematic management that put top priority on safety.
(4) To conform property with environmental changes inside and outside the company.

Based on these four goals, line employees as well as management staff attend to safety problems by respecting the spontaneity of all employees and encouraging their active participation in various activities, To support this, more than one-third of facility investments are spent on safety-related issues. As the result, the number of accident's resulting from railway operations decreased from 376 cases in 1987 to 168 cases in 1994. An outline of JR East safety measures is introduced and our future tasks are explained here.

2. Main safety facilities

Recently developed safety-related equipment, which JR East plans to expand installation of, are introduced.

(1) Measures to prevent train collisions

-- ATS-P

ATS (Automatic Train Stop) devices were installed on lines nationwide in 1966 in order to reduce train collisions. When a signal indicates an emergency stop, a device beside the track sends a stop signal to nearby trains. An on-board device which receives this signal applies the train brakes automatically. However, when a train operator presses an override button, the safety function will be canceled. Accordingly, accidents have occurred while the safety function was canceled. In order to solve this defect a new ATS-P (Pattern) system had been developed.

In the ATS-P system, as shown in Fig. 1, an onboard device determines when to apply brakes in accordance with the types of pattern set by the data transmitted from devices beside the track. If an operator applies the brakes or an signal allows a train to speed up before the train arrives at the location set by a certain type of pattern, the brakes will not be applied. Otherwise, the brakes will be applied automatically.

The ATS-P system was set up in 1988 and at present the devices have been installed on 700 kilometers of line sections.

(2) Measures to prevent accidents at level crossings

Level crossings where a railway track and road intersect are the weak point of safety. The fundamental measure is to construct multi-level crossings to avoid the problem of level crossings. However, as there are issues of construction costs and land acquisition, the project is moving ahead very slowly. For this reason, the following steps are being taken for improvement of safety at level crossings.

-- Obstacle detection device

When a vehicle stops inside the level crossing, it is detected by a device using a laser beam or electromagnetic induction. A special signal is then transmitted to a train operator to warn of an emergency situation.

-- Wide crossing gate or double gates

Crossing gates are made wider or double level for the purpose of stopping a driver who attempts to forcibly pass through a crossing that is being closed. In addition, crossings are designed to be free of obstructions, so that they can be seen from a distant.

After introducing the above measures, the number of accidents at level crossings has decreased more than 70 percent over seven years. Also, front parts of rolling stock are made of material easy to collapse so that a shock can be absorbed at the time of a train collision in order to minimize damage to passengers and the train operator.

(3) Measures taken at the time of maintenance

Various measures are also taken to prevent accidents such as train-worker contacts, electric shock and falls, resulting from maintenance work on the tracks, overhead wires and rolling stock. As a report about these problems is planned later, a device which automatically measures thickness of pantograph sliding plates will be explained here.

-- Device to automatically measure thickness of pantograph sliding plates.

In the past, workers climbed on top of a train to measure the wear of pantograph sliding plates. As the result, they were often involved in accidents such as electric shock and falls. This device was developed to avoid such accidents.

The device is installed at the incoming and outgoing sections of rolling stock depots. When a train enters a section, the device automatically detects and reads the number of the rolling stock. At the same time the device directs a supersonic signal at the pantograph sliding plates. By measuring the arrival time of the reflected signal, the thickness of the sliding plates is computed, and the results are displayed on a personal computer.

(4) Measures against natural disasters (Fig. 2)

Just as Japan is the focus of many natural disasters, JR East faces damage from heavy rains, typhoons and earthquakes every year. The following systems are installed in order to secure safe train operations during disasters.

-- Antidisaster information system

Measurement are automatically conducted in this system, based on data for heavy rains, rise in river waters following heavy rains, strong winds and earthquakes, collected by rain and water gauges, anemometers and seismometers installed along the railway lines. The data are sent to the control center and the track maintenance depots through dedicated circuits where workers can call up data on their personal computers. An alarm is issued at the control center and the track maintenance depots when a measurement reaches a set value based on past experience. Instructions are issued to slow down or suspend operations and track inspections are then carried out by the track maintenance depot.

(5) Safety measures for passengers on platforms

Passengers may accidentally fall from platform onto a track. As there are many places with limited visibility from a train operator's cab at stations in the city being often curved, and train frequency is high, accidents may occur. For such reasons, the following devices are installed.

-- Device to detect a passenger who falls on a rail line

A series of mats containing sensor wires are laid along a rail under a passenger platform. When a passenger falls on one of these mats, an alarm is sounded to warn of an impending accident.

-- Emergency train stop warning device

When station staff or a passenger on a platform discovers something unusual, he pushes a button of this device to activate an alarm device to warn a train operator or conductor to stop the train.

3. Future Tasks

Although various preventive measures are constantly taken, small accidents and errors continue to occur. Often, equipment can not correct workers' errors or workers are unable to properly handle equipment because it is new or devices malfunction.

JR East has about 80,000 employees and hires about 1,000 new workers every year. As many employees are now reaching the age of 50, a new generation will soon be in place. Consequently, JR East has to simplify operations so that its employees can display their ability to a certain extent after only a short period of study and training.

Progressing with mechanization and systematization in the future, JR East has to create a system to operate railway businesses with fewer personnel. With this in mind, the measures to insure safety will become broader in scale and more complicated. There is also the possibility of new types of accidents.

In order to deal with these problems, the planning division, the research and development division and the field work division are jointly promoting new safety measures. The following cases are introduced.

(1) Equipment to educate operators

Future operators take study and training courses at the research and training center and later receive field training. In order to learn efficiently and effectively, teaching equipment using simulators (that can be adjusted to each student's level of understanding) in combination with large computer-graphic displays will be introduced. For simulator instruction, a trainee in a mock "motorman's cab" sees a scene projected on a screen in front of the car for a simulation of an actual operation site, in order to gain realistic experience. The apparatus also has a computer aided instruction (CAI) function which aids in study concerning operations. Study can be done in accordance with each trainee's ability.

(2) Rolling stock shunting system (Fig. 3)

At present, staff members, including a worker who prepares a working schedule, a signal man, a train director and a train operator, work as a team to shunt rolling stock at a depot. This system will be automated to a large extent for the purpose of upgrading safety and saving manpower.

This new system is composed of three types -- the planning system that establishes a shunting plan when a rolling stock utilization plan and an inspection/-cleaning plan are activated, the route control system which controls trains at incoming and outgoing sections and carries out the transfer of lines based on data sent from the planing system, and a portable route control device carried by a train operator to send acknowledgments and route settings to the route control system. One operator can perform all shunting operations using this system.

(3) Reinforcement of anti-earthquake measures

In January 1995, an earthquake registering magnitude 7.2 on the Richter scale jolted Kobe and its vicinity, causing more than ten trains to derail and inflicting serious damage to railway facilities. Taking these cases into account, measures to reinforce piers and to prevent girders from collapsing are being introduced.

In addition to the above, the following measures are taken.

-- UREDAS (Urgent Earthquake Detection and Alarm System)

There are two kinds of earthquake movements-- a preliminary tremor referred to as the P-wave (velocity 8 km/s) and the principal shock referred to as the S-wave (velocity 4 km/s). UREDAS computers the magnitude and the location of an earthquake and transmits an alarm when seismographs detect the preliminary P-wave tremors. This first alarm warns that the main shock will follow. It takes less than 4 seconds from detection and analysis to the transmission of an alarm. When the following (S-wave) tremors begin, the analysis is reviewed and then a more precise secondary warning is given. By cutting electrical power from substations and slowing train operations at the time of the first warning, train will be running slowly when the principal shock reaches the area.

-- Earthquake detection/notification and train early stop system on conventional lines

When an earthquake jolts Tokyo and the southern Kanto districts where railway networks are highly concentrated, seismographs detect and notify movements, automatically sending a signal by radio to suspend train operations immediately. Two kinds of radio systems are utilized. One are radios which give an alarm when motion intensity exceeds 250 gals and which are installed along railway lines in Tokyo and vicinity where train frequency is very high. The other type are radios installed in the southern Kanto district that send an alarm when an earthquake reaches or exceeds an intensity of 80 gals.

4. Conclusion

Some of the JR East safety equipment has been introduced above.

Naturally, they were not adopted separately but equipment investments carried out after considering the frequency of accident occurrences and possibility of whether the accidents may lead to fatalities, specially paying attention to prevention of death/injury accidents for our customers and employees.

As these conditions may change over time, judgment standards are also gradually changing. For instance, if traffic rises following a population increase along some railway lines investment priority will change and safety measures of level crossing will have to be strengthened where traffic is severe.

In addition to that, as new equipment tends to become more complicated and difficult for workers to use, a new problem may arise between such equipment and its operators.
Accordingly, working conditions and the way of doing work may have to be changed along with the education and training of concerned workers at the time new equipment is installed. And, equipment has to be improved after a while since its introduction. Through steps such as these, JR East aims to realize efficient management by creating a favorable working environment for company employees along with improvement in safety measures.

Fig. 1

The Outline of the New ATS(ATS—P)

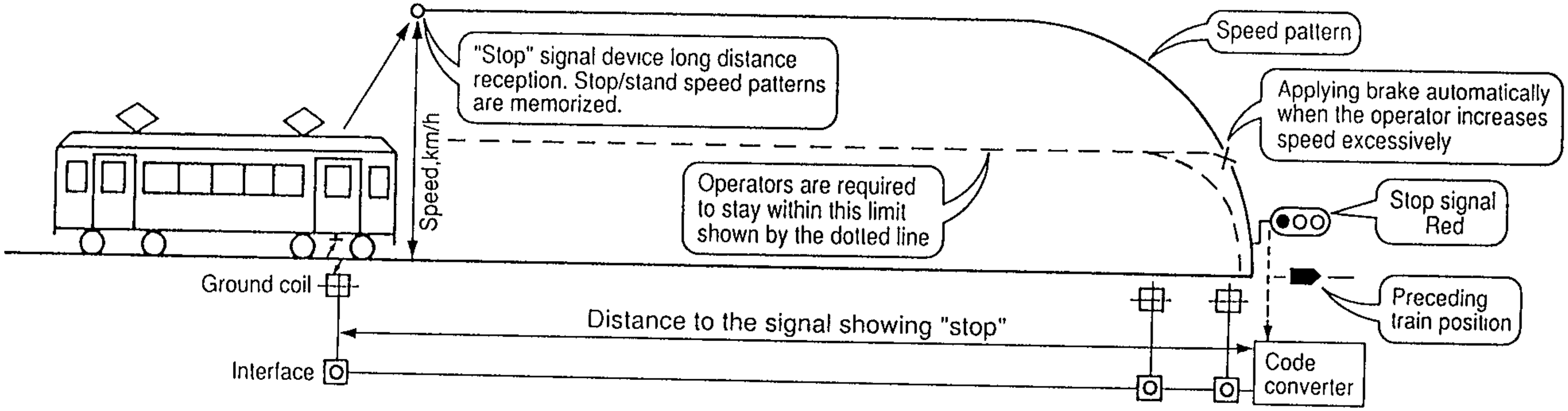


Fig. 2

Natural Disaster-Prevention Information System

A general map of the Natural Disaster-Prevention Information System

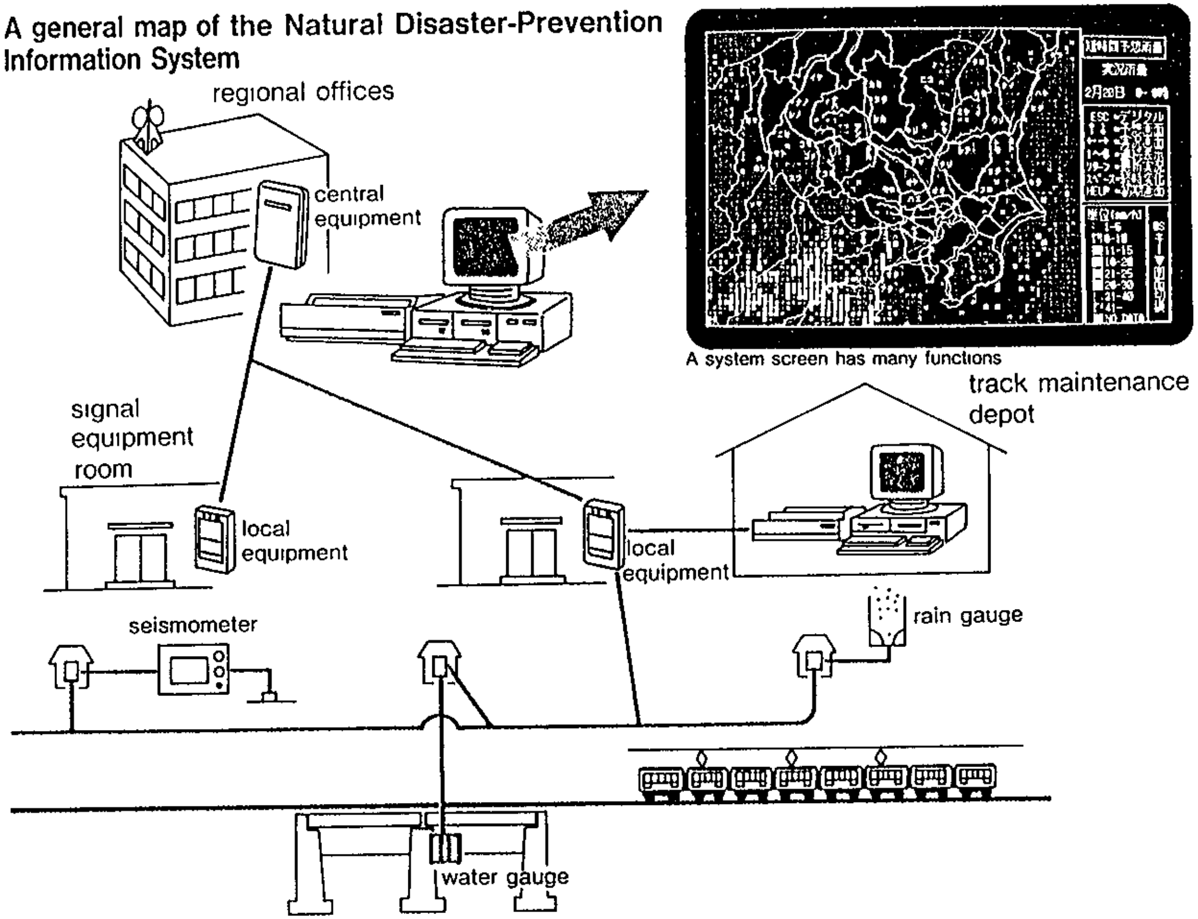
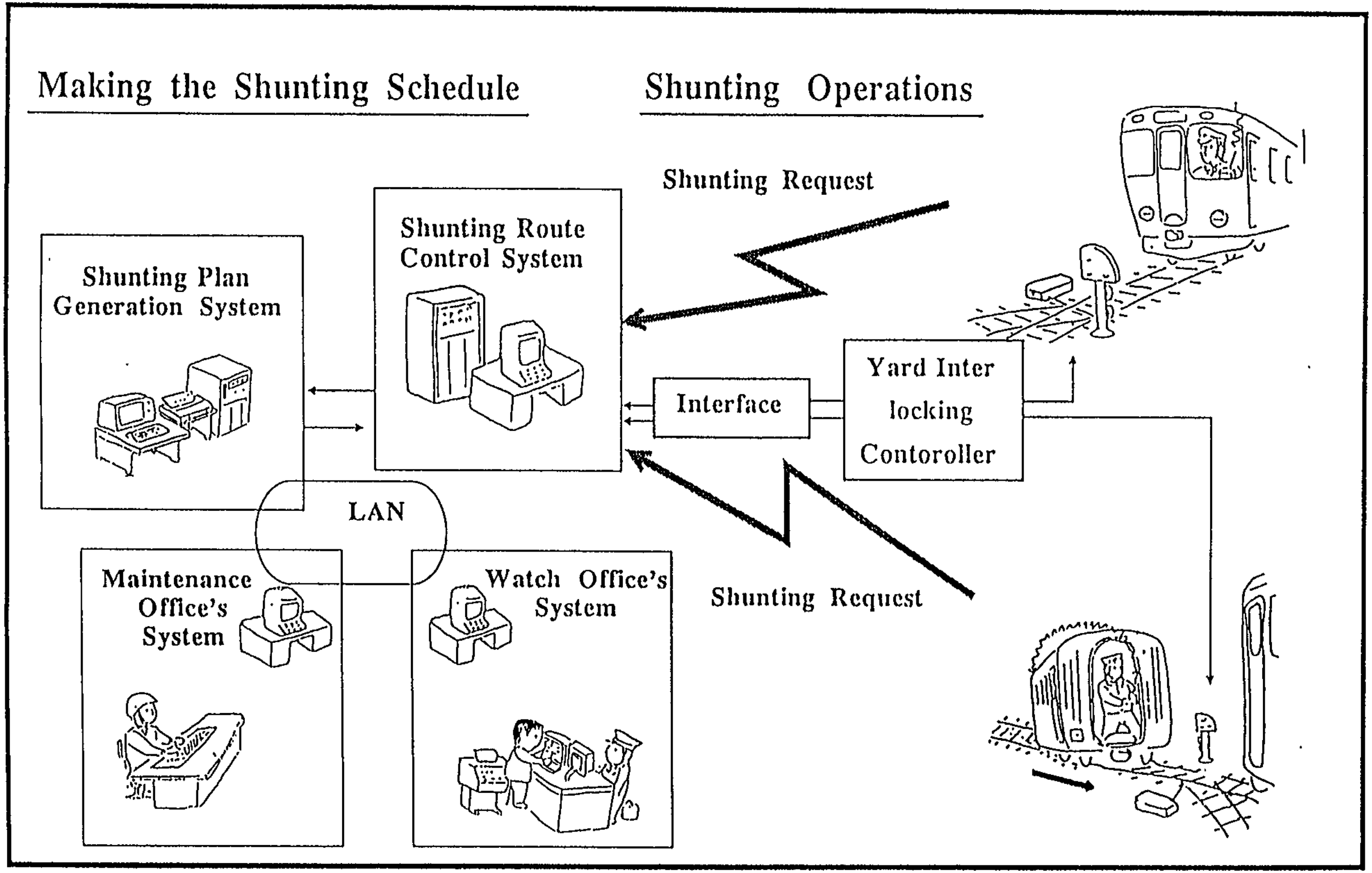


Fig. 3

Rolling Stock Shunting System



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Lucas Orve

Radio Block in Sweden An economic solution integrating positive train separation via radio and automatic train protection

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RADIO BLOCK IN SWEDEN. AN ECONOMIC SOLUTION INTEGRATING POSITIVE TRAIN SEPARATION VIA RADIO AND AUTOMATIC TRAIN PROTECTION.

Lucas Orve - SJ; Swedish State Railways

SYNOPSIS. When the Swedish transponder based Automatic Train Protection system was designed at the end of the 1970's, it represented a very important step towards more efficient and safer operation of trains. Not only was it for the first time possible to monitor a train's speed and to provide the driver with valuable advance information on signals and speed restrictions, but the system also incorporated a set of functions to separate trains on a line by means of radio carried signal information. Although this feature, known as 'radio block', was never used at that time, recognising the importance of providing an upgrade path for economic operation of secondary lines serves to demonstrate the foresightedness of the technicians that defined the basic principles of system, almost 20 years ago. However, when in 1992 the fleet was upgraded with new ATP software, it was finally decided also to take advantage of the system's ability to provide radio block functionality fully integrated with ATP. As part of this process, the radio block functions were further refined, and the line from Linköping to Västervik was selected as a pilot scheme for radio block implementation. Subsequently, the line was fitted with standard ATP transponders configured to define block sections and virtual 'signals'. Rolling stock operating on the line was fitted with data radio equipment, and wayside base stations were set up to provide adequate radio coverage. The computer based interlocking located at Linköping was enhanced with new functions for communicating with the trains, blocking/releasing track sections for train occupancy, and issuing authorities for trains to proceed within the blocks allocated. All on-board ATP indications and monitoring of the speed is carried out in a manner very similar to that used on conventional lines and therefore did not represent any major deviation from the established standards. The paper details the operational principles of the system and presents the experience accumulated during the first period of operation.

SYMBOLS AND ABBREVIATIONS

ATP	Automatic Train Protection
ATC	Automatic Train Control (equivalent Swedish term for ATP)
LoA	Limit of Authority
CBI	Computer Based Interlocking
RB	Radio Block
RBC	Radio Block Central
TCC	Traffic Control Centre

1. INTRODUCTION

Traditionally, railways have always sought methods of increasing safety, improving capacity, and reducing costs by implementing various forms of automatic support and control systems. Today's Computer Based Interlocking (CBI) systems (whether automatic block, station interlockings or other vital control systems) may serve as relevant examples of this evolution towards a safer and more economic operation of trains. A similar path has been followed in the development of highly sophisticated Automatic Train Protection (ATP) systems which, by monitoring an individual train's speed to remain within the safe envelope, greatly reduce the risk of accidents attributed to driver errors.

However, this advancing of safety technology into the computer environment has also paved the way for other elaborate and innovative solutions, such as Radio Block (RB). Essentially, this is a conventional automatic block system, in which the functions of track occupancy and train separation are handled by a central computer rather than by fixed installations such as track circuits and lineside signals. Trains report their positions in the network via a radio channel,and based on this information, the Radio Block Central (RBC) will allocate/free track sections for train occupancy. Authority to enter a block will subsequently be transmitted to the train using the same radio links, thereby eliminating the need for any track mounted components other than some form of location identifiers.

2. HISTORY

In the middle of the 1970's, SJ management took a broad look at the global safety of the railway. Some years earlier, the principle of two man operation of trains had been abandoned, and it was therefore a logical decision that some form of ATP had to be introduced to eliminate the potential hazards resulting from driver errors. Subsequently, a committee of experts was formed and charged with the responsibility of setting up the specification for the system. As a base for this task, a number of general system requirements were established:

- Operation without continuous communication with the signalling or other systems
- Minimum amount of track mounted equipment
- Minimum amount of cabling

These basic features were then supplemented by a secondary set of requirements:

- Update of signal information via radio link
- Radio carried authorities to enable RB functionality

Based on the above principles and an extensive trial programme, the first version of the Swedish ATP system (ATC1) was specified and developed in 1977. The first serial installations were made in 1978, and since then all main line locos, EMU:s and DMU:s have been fitted with ATP. The same applies to the mainline rail network, which is now covered to almost 100%.

It is interesting to note that already at the time when the system was originally defined, almost 20 years ago, basic radio block functions were established and integrated in the on-board program. However, whilst in many respects very advanced, these functions were found to be somewhat too primitive for practical use. As a result of this, actual radio block operation was never introduced at that time. Therefore, when the second generation of the on-board software (ATC2) was developed at the end of the end of the 80's, the two suppliers of the system, ABB Signal and Ansaldo Trasporti, were invited to discuss a solution to the problem. As a result of this discussion, it was decided to refine the radio block functions and to develop the corresponding central control functionality. For this purpose, the line from Linköping to Västervik was selected as a pilot scheme. Please refer to fig. 1.

Fig. 1 Pilot Scheme Linköping-Västervik

The existing computer based EBILOCK 850 interlocking at Linköping was enhanced with new functions for communicating with the trains, blocking/releasing track sections for train occupancy, and issuing authorities for trains to proceed within the blocks allocated. At the same time, ATSS L 10 000 on-board ATP systems were upgraded and supplemented by radio interface and data radio communication units.

3. SYSTEM DESCRIPTION

3.1 General ATP Principles

At signals, speed boards, and wherever information is to be transmitted to the train, a set of *transponders* are deployed in the centre of the track between the rails. Normally, such a set contains two transponders, but at specific locations where this is insufficient, three or four units may be used, depending on the amount of information to be conveyed. This basic philosophy is employed to provide (a) a first level of detecting a missing transponder and (b) a means of identifying the direction(s) to which the information pertains. transponders can be either *fixed* or *controllable*. The former type is used for those cases where the information content remains constant, whereas the other type is used when the information content is controlled by signal aspects etc. Please refer to fig. 2.

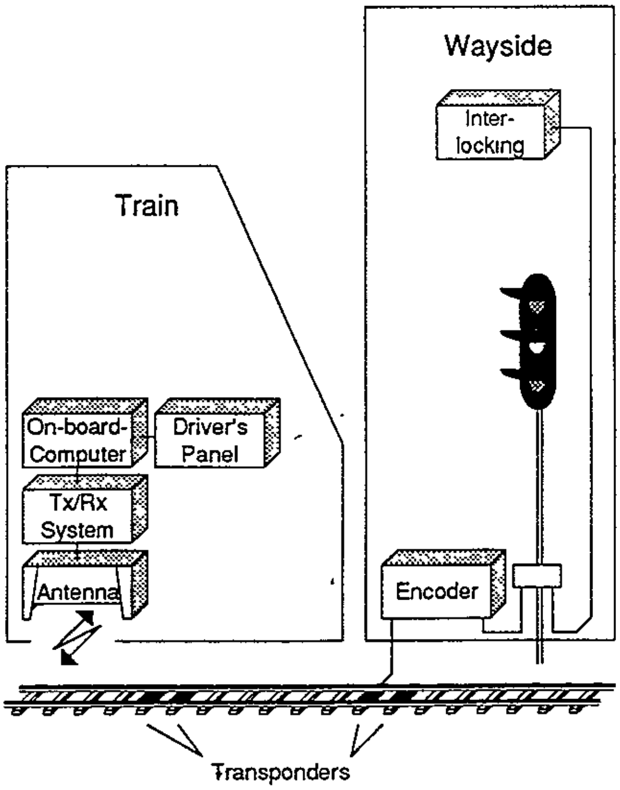

Fig. 2. Block Diagram for Basic ATP Configuration

Transponders are passive devices, i. e. they do not require any power other than that transmitted by the train. The on-board antenna, mounted under the loco frame, continuously transmits a 27 MHz signal. When passing over a transponder, this signal activates the electronic circuits and causes the transponder to respond by sending its information to the train in the form of a coded telegram on 4.5 MHz.

For a typical transponder location, the information transmitted can be summarised as follows:

- Valid Limit Speed, i. e. the speed permitted from the location where the transponders are installed
- Target Limit Speed, i. e. the speed permitted from the target location
- Basic Distance, i. e. the distance to the target location. When applicable, this distance is used also to identify cases where an entire transponder group is missing
- Gradient (optional)

This information is compared with train data entered by the driver on start-up of the on-board system, which enables this to set up and monitor the appropriate warning and braking curves. Please refer to fig. 3.

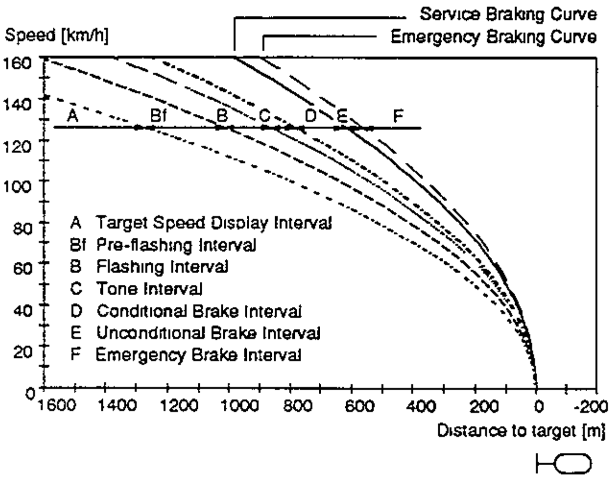

Fig. 3. Warning and Braking Curves

Several sets of warning and braking curves can be handled simultaneously, and speed restrictions are treated separately from signals. This allows the system to monitor the train's speed such that this will always remain within the safe envelope as dictated by the individual conditions at hand. Please refer to example in fig. 4.

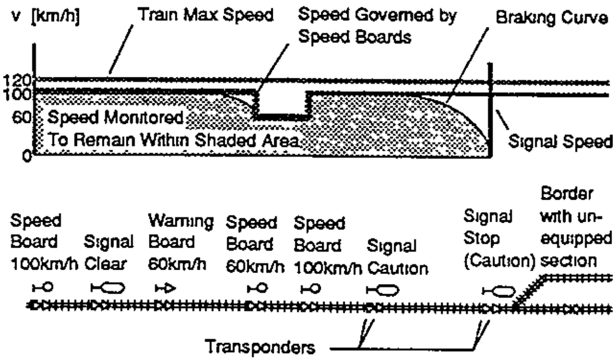

Fig. 4. Conventional Line Fitted with ATP

Relevant information, including permitted speed and target speed is presented on the ATP panel located on the dash board in front of the driver. Please refer to fig. 5.

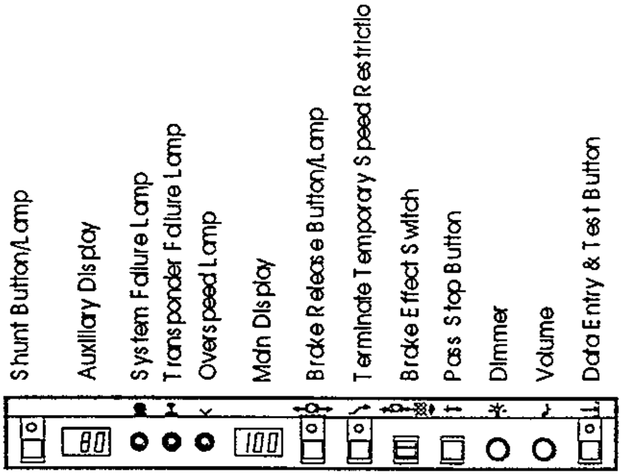

Fig. 5. ATP Panel

3.2 General Radio Block Principles

Conceptually, an RB line is divided into separate block sections in a manner similar to that employed for a conventional block system. The line between two stations may be split up into an arbitrary number of blocks delimited by sets of transponder providing location and distance information. Different blocks can be defined for the two opposite directions of travel, which is also used as a means of setting up appropriate overlaps, etc. All signalling information is transmitted by radio, and the interlocking is therefore equipped with interfaces to establish communication with the trains via radio base stations distributed along the line. In a similar manner, the on-board ATP systems are enhanced with radio interfaces and radio transceivers for data communication. All radio messages are acknowledged by the receiving part and the integrity is verified by established safety coding algorithms. Train regulation, route setting, etc. is established from a central location using the same principles as a conventional Traffic Control Centre (TCC). Please refer to fig. 6.

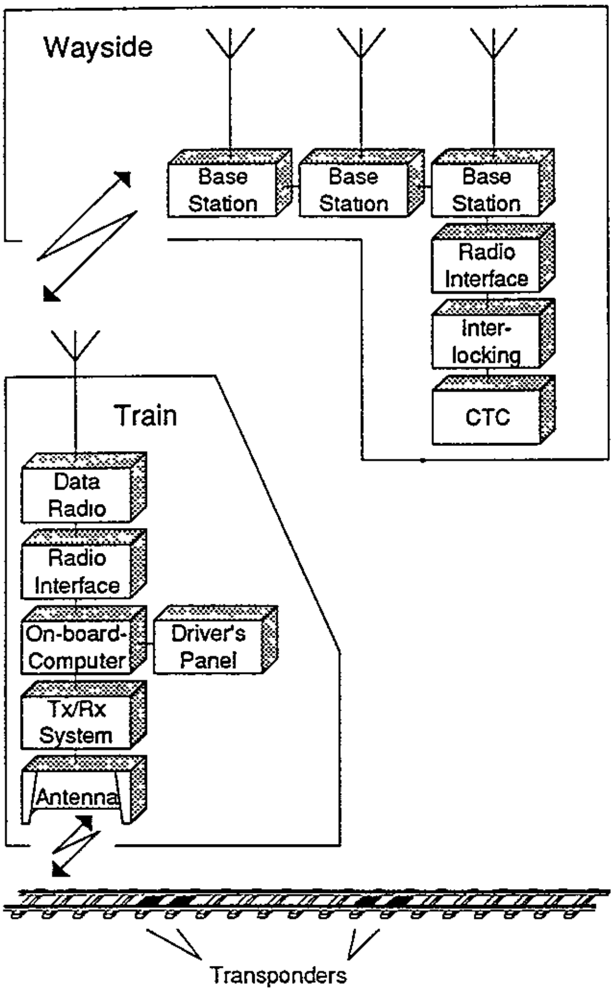

Fig. 6. Block Diagram for Radio Block Configuration

When defining the RB operating rules of the system, it was considered very important that these should deviate as little as possible from those applied under 'normal' conditions. Therefore, most functions and principles are identical to those in use on a conventional line, e. g. for speed restrictions. However, in the case of RB, lineside optical signals have been replaced by sets of transponders identified by a marker board, and therefore all signal information is given to the driver by means of the ATP panel. Since such transponder locations basically serve the same purpose as signals, they are generally referred to as 'virtual signals'.

For a typical virtual signal, the information transmitted can be summarised as follows:

- Unique ID
- 'Stop' information, revisable by radio telegrams from the RBC
- Distance
- Gradient (optional)
- Radio channel switching information etc.

The following example details how this information is used by the on-board system and the RBC to establish train separation in an RB area:

Train 01 sits on the block immediately at rear of 'virtual starter signal 33'. Train route from this signal has been requested by the signalman, and therefore the corresponding blocks have been reserved for the train by the RBC. Subsequently, the route will be locked and a telegram containing permission to pass 33 will automatically be sent via radio to the on-board ATP system. This message represents an authority for the train to enter the next block and sets the Limit of Authority (LoA) to the end of that block. This is indicated to the driver by displaying an 'F' (F='free') in the main display of the ATP panel. Please refer to fig. 7.

The train passes virtual signal 33. This means that the LoA is now the end of the current block as defined by the distance information contained in the transponders at signal 33, The 'F' is therefore extinguished and at the same time, the on-board system will transmit a request to enter the next block, i. e. to pass the virtual advanced starter L41. Provided this block is free for train occupancy, this will then be allocated to train 01 and the RBC will send a telegram giving the train permission to pass L41. Please refer to fig. 8.

The train now passes virtual signal 22, which is a home signal for opposite direction of travel. On having travelled a full train length, this results in the on-board system transmitting a telegram indicating that the previous block has now been cleared for occupancy by another train. When this information is received by the RBC, train 01 will be removed from the block, enabling the setting of a new route into this. Please refer to fig. 9.

On its journey towards the end of the route, i. e. virtual starter 33, train 01 passes L04, which is the next signal for the opposite direction of travel. The corresponding block is then freed, which allows a second route to be set up to L03. Since this route has been requested for train 03, currently positioned at rear of signal 33, the corresponding authority is transmitted by the RBC. Please refer to fig. 10.

Train 01 proceeds along the line whilst receiving authorities to enter blocks ahead and sending information on blocks cleared back to the RBC. When passing virtual home signal 21, train 01 sends a request to pass virtual signal 33. However, in this example signal 33 represents the end of the route, and therefore the RBC will not send such an authority. As a result of this, train 01 will not be allowed to proceed beyond 33 which is at 'stop'. Please refer to fig. 11.

Train 01 has stopped at signal 33. Train 03 will therefore not be allowed to proceed further than up to virtual home signal 22 which is now also at 'stop'. Please refer to fig. 12.

3.3 Special Radio Block Procedures

The above sections describes the basic principles of operation under RB. However, in certain cases, such as entering and exiting an RB area, special procedures have to be applied in order to satisfy the safety requirements. Some of these procedures are detailed below:

Entering and exiting an RB area
All trains operating under RB area must be *registered* in the RBC. When entering an RB area from another line, this is done automatically on passing the transponders preceding the signal controlling the entrance to the RB area. If on the other hand, a start-up of an ATP system is performed whilst in the RB area, e.g. when splitting multiple units into two trains, then registering with the RBC is carried out as a manual procedure involving the driver as well as the signalman. If an attempt is made to move the train which is not registered, then the brakes will be applied on passing the first virtual signal. Similar rules as described above apply when exiting the RBC area.

Manual blocking of track section
To provide adequate protection for track maintenance works, inspections, etc., a section of the line can be blocked manually by means of a hand held radio terminal. Releasing the section must be done by the same person using the same terminal. A similar procedure is used when shunting in a station area or when working a train not equipped for RB operation through the system.

Stations
Stations can be controlled from the central interlocking in the same way as on a conventional line. However, in many cases a simple arrangement based on spring-operated self-normalising points and an indication lamp is sufficient, which greatly reduces the complexity and the investment costs. In the latter case, the permitted speed is limited, but to some extent this can be compensated if the station is designed with sufficient overlaps for simultaneous entrance from both ends.

Level crossings
Level crossings are currently regarded as independent systems, not implemented in the RB system. However, future development plans include also the control of level crossings from the RBC based on train positions reported.

3.4 Radio Block Hardware

The system uses the following hardware components:

Interlocking computers:	Ericsson APN 586
On-board computers:	ATSS L 10 000
Radio Interfaces:	SMS
Radio base stations 450MHz:	Ericsson F800
Radio mobile stations 450MHz:	Ericsson C700

4. EXPERIENCE FROM OPERATION

Following a start-up period of operation in parallel with manual procedures, the RB system on the line Linköping - Västervik has now acquired approximately 6 months of full service. After some initial problems, mainly due to adjustment and fine-turning of the radio coverage, the system has proved to work very well and in accordance with the requirements set out in the specification. Not only has the prime objective been achieved, i. e. to eliminate the need personnel at the stations along the line, but the system has also introduced a much higher capacity and flexibility in the operations than previously. This is mainly due to the centralised traffic control and the system's capability of handling several blocks between stations, as opposed to manual operation where the whole line between two stations is regarded as one single block. The pilot scheme has also demonstrated that the system requires very little maintenance, and due to the absence of colour light signals, track circuits etc., regular inspections are virtually eliminated. Combined, the above has clearly established that RB is a very efficient means of providing high quality rail services at low cost. This is particularly true for secondary lines where the investment in conventional automatic block systems cannot be justified, but the experience from the pilot scheme also supports that RB in the future will be considered an alternative for more densely trafficked networks.

5. CONCLUSIONS

The Swedish RB has proved not only to be a very cost-effective means of operating a railway line, but also to provide the same flexibility and efficiency as a main line automatic block system. By transmitting vital signalling information to the train via radio and then monitoring the speed to remain within the safe envelope, a large proportion of the wayside equipment can be eliminated. As a result, a high degree of safety and flexibility can be established yet reducing maintenance and infrastructure investment costs to a minimum.It is further interesting to note that the functionality of the RB system is very similar to what is envisaged for ETCS level 3, and the results from the pilot scheme therefore support the idea that such systems will find extensive use in the future.

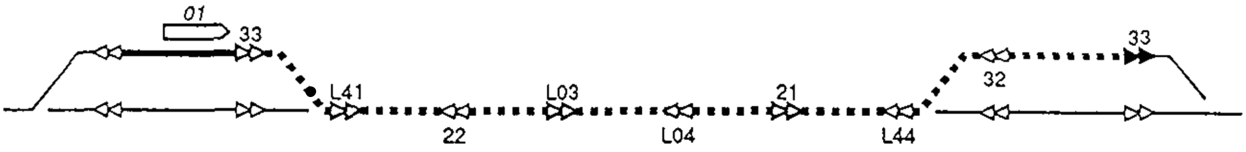

Fig 7. Setting a route and sending an authority to pass a virtual signal

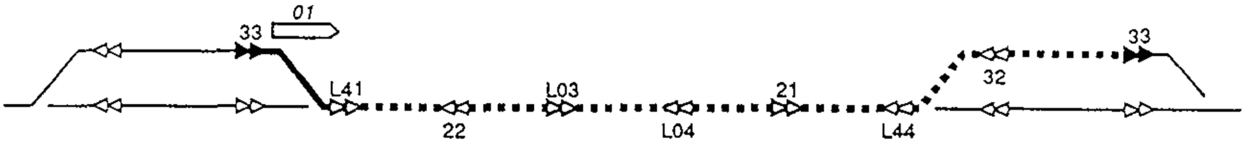

Fig. 8. Requesting next block

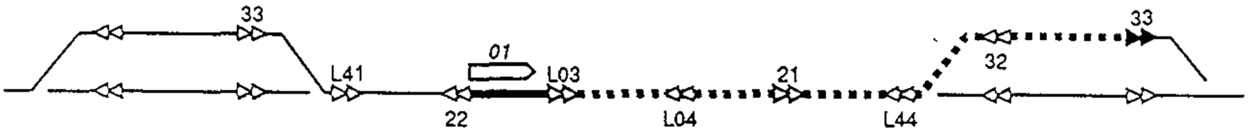

Fig 9. Clearing a block

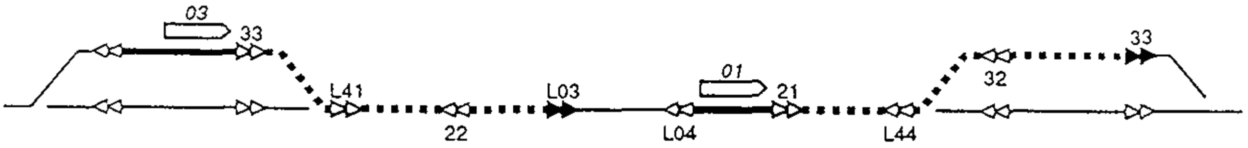

Fig. 10. Setting a second route

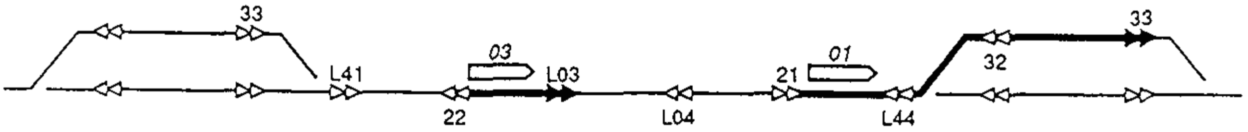

Fig 11. Virtual signal at 'stop'

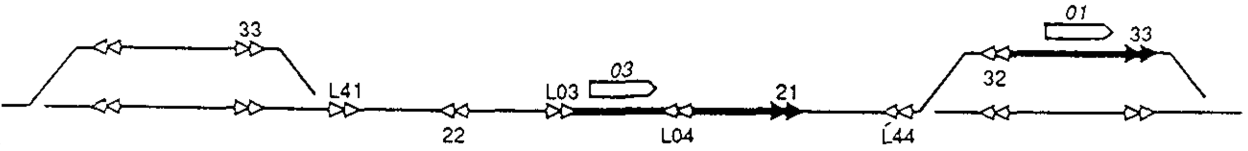

Fig 12. Second train stopped