EUROPEAN FEDERATION
OF MUSEUM & TOURIST RAILWAYS

Fédération Européenne des Chemins de Fer Touristiques et Historiques

Europäische Föderation der Museums- und Touristikbahnen

International Heritage Railway Conference

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Conference Proceedings

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FEDECRAIL
CONFERENCE AND AGM BUSINESS PROGRAMME

Session 1: Friday 30.5.97 - Stockholm Central Station

13.00 - 13.05	Opening words of welcome to Sweden (Sven Freden)
13.05 - 13.10	Welcome from David Morgan, FEDECRAIL President
13.10 - 13.40	Opening address : Stig Larsson, UIC President and SJ Director-General
13.40 - 13.55	Address from Sponsors: Christian Guldberg (ABB Daimler-Benz Transportation Signal AB)
14.00 - 14.30	Aidan Nelson, Director Rail Safety, Railtrack Plc (UK) Paper: "Risk Assessment of Level Crossings"
14.30 - 15.00	Anders Wedzinga (Railway Safety and Legal Affairs Officer), Railned Spoorwegveiligheid (NL) Paper: "Cheaper Level Crossing Signal Systems"

---------- Coffee and Tea Interval ----------

Sessions 2:

15.30 - 16.00	Jean-Paul Balensi UNECTO Union des Exploitants des C de F Touristiques (F) Paper: Comparison of Regulation of Level Crossings for Museum and Tourist Railways in Various EU Countries"
16.00 - 16.30	Bengt Hultin, Railway Inspectorate (S) Paper: "The Swedish Railway Inspectorate"
16.30 - 17.00	Thomas Engel, Alvsborgs County Cultural Heritage (S) Paper: "The Deficiencies of the Swedish Cultural Act"
17.00 - 17.20	Leonid Moskalyov, October Railway Museum, St. Petersburg (Paper/Informal Talk on October Railway Museum and Introductory Overview of Russian Railways and Preservation Societies)
17.20 - 17.50	Ing. J Quellmalz, ISD/Innovative Steam Development Paper: "Technologies for improving steam locomotives for a more environmental-friendly operation"

---------- SL Trains to Barkaby dep. 18.10, 1822 (arr 18.25, 18.37)----------

Session 3: Saturday 31.5.97 - Stockholm Central Station

09.30 - 10.15 Dipl Phys Reinhard Serchinger (Title ?) (D)
Paper: "Analytical Researches of Steam Loco Smoke Emissions"

10.15 - 11.00 Debate: "Joint Research Projects - a future activity for FEDECRAIL?"

---------- Coffee and Tea Interval ----------

11.30 - 13.00 Annual General Meeting - Delegates who are not "voting card delegates for members" are welcome to participate in AGM

---------- End of main business sessions ----------

ADDITIONAL BUSINESS PRESENTATIONS:

(a) SCANIA Museum Lecture Theatre Sunday 1.6.97 (18.30/19.00 to 20.00 hrs)

- "SCANIA Past and Present" - introductory presentation on history of the Scania-Vabis company and its museum collection and the present-day activities and products of the SCANIA group (talk and video)

- "Railway Preservation in Sweden" - Outline of development of preservation in Sweden; Including glimpses of some railways and museums not included in conference and railcruise programme - Sven Freden, Chairman, Museibanornas Riksorganisation (Illustrated talk)

(b) Midnight Sun Railcruise - Various location(s) during the Railcruise:-

- "Safety Audits - Unravelling the Mystery" - Address by David Madden, Certified Safety Programme Auditor; Board Member AIRPS (UK)

- "Practical Aspects of Environmental Management for Museum Railways" Address by Tony Tomkins, Environmental Management Services Consultant, Fourtees Consultancy, Milton Keynes (UK); President Leighton-Buzzard NG Rly

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CONFERENCE STUDY VISITS/SOCIAL PROGRAMME

Fri 30.5 - Conference Dinner Cruise on veteran steamer on Lake Malaran
Sat 31.5 - Tour 1: Uppsala - Lennebanan with barbeque evening meal
Sun 1.6 - Tour 2: Stockholm Museum Tramway; Vasa Museum; Mariefred Railway; Gripsholm Castle, SCANIA Museum

Fedecrail 1997 Conference

David Morgan: I then go on to the question of research. I asked a leading question earlier on of ~~Bryan Heart~~ as to what he thought we should... what further research we should be carrying out. His answer was rather than starting new research we should be putting into practice what the lessons we have already learnt. That was his view and it may be the right view. I would just like to know are there any points that people want to raise as whether we should be undertaking research into any area and if so how we should go about it? I can see ~~Yupnevote~~ with his hand up. ~~Yupnevote~~ of HRM the Netherlands.

Yup: Thank you, David, well I think in general spoken I would like to propose the board of Fedecrail to make proposals on any type of research projects. Lets say before the end of the year, so that the individual members can discuss it with their members. The things, how much money and things like that. For the things discussed this morning I think it is much more complicated than just ashes and things like that. So it would be interesting first to make infantirisation (??), what time, what government Europe is going to do the next five to ten years and what we should do on it, minding we can see forwards to the proposal in that way after the Fedecrail board.

David Morgan: Thank you very much, ~~Yup~~, David Potter at the back there. While the microphone is going to David Potter, in answer to that. That is a topic which I will raise at the next council meeting. Before then, being one of my increasing numerous visits to your country ~~Yup~~, I shall do a detour down to Hörn in between lawyers and see what suggestions you have to make so that we can put some proposals in writing to you before our next meeting. David Potter:

David Potter: Yes, thank you. My point is, I thought the next possible research project was in fact suggested this morning, which it was in fact for the research to be done, a project modelled on working at how the practical implications of what you heard about the steam engine this morning in practice. I mean the sort of suggestion was made that perhaps a railway might use different kinds of coal, to see whether it worked better and that sort of thing, and that will take quite a lot of coordination. It will need somebody appointed to plan the project of how these things are actually working out in practise, and to draw comparitable scales in this sort of thing and that strikes me as quite a good research project because it will show what actually happens in practice, but it would have to be organised. Thank you.

David Morgan: Thank you David. Could I ask you David to put something in to writing for me? You can do it in note form, I'm quite happy, but I have not been making a note. I think that rather leads me into the next point I wish to raise under this... Is there any other question on research, I don't think ~~Ryan Heart~~ REINHARDT, because I suspect he's keeled over after a whole night of drinking Munich beer, followed by then writing his speech that he gave this morning. He then had to raid some archive to steal the photographs that he showed on the overheads, and he's now probably in some Swedish prison. I assume that ~~Ryan Heart~~ REINHARDT has truly keeled over. Yes he has disappeared from view.

Unknown: I can assure you he is changing his clothes and coming for the lunch at 13:00.

David Morgan: Ah, well I'm getting a little worried because of his earlier reference to firing an engine. I think he likened it to firing up a lady and I hope it's not one of those activities he's now indulging in.

Could I now lead in to... are there any points on research just before I leave that? I think this is an opportunity for me just to lead into a memo which was sent to me by Sven Freden on the 12th April. Sven if you recall, suggesting the setting up of sub-committees to really implement the work, but there is a danger because we meet so seldom that we don't get the impetus going for seeing things through and that is a matter that concerns me. What Sven, if I may summarise, but if you think I got it wrong please tell me. What Sven has suggested is that we should set up project groups, probably, I think of fairly small numbers, to carry out work on certain topics. He has suggested six different topics, one was culture, which is the cultural role of different railways. To analyse and document that. Secondly was environment and in particular with reference to smoke emissions and other emissions. Thirdly was safety and someone I discussed this actually said that I should include that boiler regulations. I think there is something to be said for harmonisation. Fourthly marketing and in fact we are already starting to do something along those lines that Livius Kooy and David Madden between them are hoping to produce some sort of, at least a handbook which will identify all the railways that belong to our association and a leaflet like that, well obviously we will have to consider first of all how we collate the information and secondly how we pay for it, and thirdly what value such a leaflet would have. But that is something that we have got underway already. Fifthly he has mentioned the subject of volunteers,

saying that we could make a much better railway with more volunteers, but many potential volunteers may hesitate to enrol in the museum for different reasons and he thinks we should seek to identify the obstacles and try to overcome them. I would add in to that actually Sven, the proposition of training, because I think training is an important feature. We've heard from our absent German friend who is pretending to change his clothes, that the way you fire a locomotive has a very great effect on the smoke emissions that you put out. Finally Sven identified the subject of economic support. I would again, he talks about economic support from European Union, because it is difficult to obtain. I again would say I would widen that to finance generally, to see how finance may be obtained. But I wouldn't actually necessarily restrict it to European grants. These are just my views, I have not discussed them with you yet Sven. I don't want to try and make a formal decision today, we don't have time and it would be unfair on you. But I think Heimo said last night during a meeting, that we really do need to know where there is an interest in any of these topics I bare. Believe it or not, despite what I do and say we are not just here to enjoy listening to my own voice or even the voice of Heimo, Rick, well we haven't really heard Livius or that Scottish Gentleman outside, oh in the balcony. *(Laughs)* I live in hope he may throw himself off, oh golly he's got a fan, that really is... We don't have too many blind ladies that belong to this(...?). I joke, but could I just ask, what is the sort of view on the member on that, we've got to remember if we set up a committee it's going to have a financial impact, because just as the council meet and we've only met three times this last year, we have to fund the cost of those people meeting. Now I don't suggest we have more than three or four in any one committee and I would want start with a pilot scheme in one area if we do go ahead. But I just would like to know first of all whether people feel that is an idea worth developing, and if so what area we should be giving priority to. Are there any comments? Sven did you want to add anything to what I've said?

Sven: Just on a practical basis, I thought of this yesterday. We have got a lot Gorts(??) Lectures about level crossings. There is very much said about level crossings, very much good things said, much things that we could use. But when we are leaving here, and I am leaving here now tomorrow, what have I (...?) I would like to have all those information collected in some useable way, because I have probably some time whether it is now or later on, arguing with authorities about the level crossing. If I then have then information and the other affliction I did when I listened to this, that I know I would be working with traffic safety in twenty years or whatever

it was, on the road traffic safety, and I know there is a lot of scientific work, more or less high quality of course, but there is a lot of safety work done on level crossings. Why not collect this? Why not use it? Why are we not trying to make a handbook which we can show to authorities and say well I know this problem, I have facts, I can argue with you and just not coming as we often have done creeping and crying and saying "Oh help us, we are ruined, we can't do this, we can't do... the whole weak thing be possible for us (??)". This type of argument doesn't buy to the authorities. They say "That's not my problem." Or ignore until it's there own fault. This is what I want to have. I want to have facts, arguments based on truth, worthy facts. There are such things and I think this is equality sort, perhaps this is a too pretentious word, I think we can just say collect information and produce information, in a readable way. Thank you.

David Morgan: Thank you very much. I think you've put finger on an important point there. Could I ask John Bennett to have the roaming mike. Are there any other people who can ask a question on this topic? Thank you.

John Bennett: Carlos is asking me to make a point, which was that the paper we heard yesterday from Thomas Engles about, it was titled "The Deficiencies of the Swedish Cultural Act" which is a rather strange title, actually raised some very interesting points about, if you like, a basic conflict in the preservation movement between the museum ~~wallers~~ wallahs (?) and train operators. The basic thing, for example, is a locomotive like a picture which you hang on the wall or is it something which you restore and maybe modify, like converted oil firing so that you can run it? Thomas was talking about a lot of things which Carlos certainly thinks ought to be discussed a lot more. If we are going to form a committee or several committees would that be one of them?

David Morgan: You are suggesting the cultural theme as being of urgency.

John Bennett: Well there is this sort of absolutely basic division, if you like, in the preservation movement between railway operators and museum people and it is something which has to be resolved. It might be of interest to the train operators and most of the Fedecrail are train operators, it might be the interest of the train operators to get in at the bottom some how before all the museum people start cataloguing our artifacts as things we can no longer modify.

David Morgan: Well, I have some interest in what you say, because in Britain we have something called the National Lottery which has resulted in quite substantial sums coming to railways and the head of lottery has just been tasked with the setting up of a policy unit, so that they will decide policy and I am very anxious, because I also wear a hat representing operators of what are known as "Old Ships", that we establish some heritage policy for both railways and in fact ships. So that we're there in front of them so that we can say "Look here you are, there is a policy already." I think it is suggested we'll come to this in a minute, but that may be a topic that we are going to discuss anyway in Barcelona.

I am rather anxious to finish on time so what I think I'm going to do is anyone with ideas on this we are going to be on the train, many of us for the next six or seven days and I would like to have any ideas then. Those of you who are not coming on the train please feel free to write to me and I will make sure that at the next council meeting which is probably going to be held in October, in some foreign country called the Netherlands, that we will discuss how we go forward and how we should plan for this. Ok thank you very much Sven I think that is something we can certainly build on, but it is going to be a gentle approach I suspect, because we are going to see how it works out. I think there are already things that we can do because I am very conscious of the need to put the conference speeches, I understand the conference is being taped is that right, ~~Shell~~ Kjell? So that it is being recorded and I think the speech this morning by the well known German gentleman now reclining somewhere. As well as Thomas Engles will be, I think should be published in full, so at least you will read that. But I think that we need to go one step further, which is then to produce some sort of advisory sheet or booklet and I liked your idea about the handbook, for example, on level crossings and I think we need to take it that one stage further. Well thank you very much.

If I could just go on to update. What I think I have really covered current activities. I'm not aware of new European regulations at this stage unless someone tells me to the contrary. I do need you to tell me if you spot something, because don't assume that we've seen it. Very often, I mean I remember and as I think you flagged up something three of four years ago and if we hadn't done that we might well have had the (???) outside of that legislation. We have to date been able to amend four different draft directives from the European Union because we were advised in advance and we do have our friends in the European Parliament as well as Mr Kinnock who is

now the Transport commissioner and we put him on the footplate of one of our locomotives last September, so he is learning a bit about steam trains. if only ~~if~~ because his wife was the daughter of a signalman. In those days they only had signalmen.

We cover a short conference evaluation. I was going to allow about half a minute for this. I think what we really need is criticism, if we are doing it right we probably don't need to be told. I think there are lessons we can learn. I think that unfortunately there was some break down in communications, some of the lists weren't fully up to date. I think also that we should have given more prior notice of what the arrangements are, where you have to be and when. But because of the heavy work load, unfortunately my partners seem to expect me to do some work in between coming to these conferences, which I ~~except~~ accept as totally wrong, and I believe that ~~Shell~~ KSELL (???) expects to so some work at the railway museum for some perfectly extraordinary reason!

I really want your criticisms. Are there any points which you feel we should pick up on? John, don't forget this shall be strung around your neck next year.

John: I have one question on, bearing in mind that we had some sponsors who came here and wanted to speak to us in order to justify their money, so to speak. Was the six or the seven hours allowed for the speakers in the conference programme was that enough? Is there a lesson to be learnt here for next year, that perhaps we should allow a bit more or allow the sponsors to speak a bit less?

David Morgan: Can I just, before I ask whether, Christian it's a bit unfair to ask as he is the only sponsor who happens to be here. One thing, lesson, that I think has come out and I have spoken to ~~Shell~~ KSELL about this. My personal view is that we ~~are~~ try to cram to many speakers into too short a period and my view is that speakers should be invited to speak for half an hour. If it's going to be meaningful we need at least half an hour, ~~at~~ After half an hour they should then be allowed fifteen minutes to answer questions. Yesterday we were hopelessly overrunning and even those that shortened their speeches spoke for about forty minutes. Christian do you want to say anything or would you rather keep quiet? I am holding to Christian who is also involved in one of the railways that I think we are visiting on Monday, if I understand his wife correctly. Did you want to say anything Christian? You are not obliged to, but did you feel...

David Morgan: Thank you very much Shell. Are there any questions? In that case it leaves me to thank first of all the owners of this conference centre for giving it to us for free of charge today, many thanks. I like to thank our excellent technician, who had to rush to and fro, for all his hard work. I hope he could understand that. Lastly I would like to thank our excellent interpreters we may see them again in Barcelona but I think they have done a first class job so I would like to thank them as well.(....)

Independent Forum

FEDECRAIL goes to the Far North

Peter Ovenstone writes

More news this month on the European front from FEDECRAIL, the AIRPS for Europe (a background briefing about FEDECRAIL's aims and activities was given in Independent Forum in the July 1996 issue). Following the success of the 1996 FEDECRAIL Conference which AIRPS hosted In Birmingham, the 1997 AGM and conference will be held In Stockholm from Friday 30 May this year to Sunday, 1 June at the invitation of our sister body Museibanornas Riksorganisation (MRO), Sweden's museum railways' association.

From the outset, FEDECRAIL has aimed to address problems shared by heritage railways In different countries. At the request of the French members, FEDECRAIL's 1997 Conference Is therefore focussing on the safety of level crossings on heritage railways. In addition to a comparative review of the present regulations in various countries, papers will be given by Aidan Nelson, Special Projects Development Manager of Railtrack on a sensible approach to risk assessment of heritage railways level crossings, and by Anders Wedzinga of 'Rail ned' (the Dutch equivalent to Railtrack) on what protection should be appropriate to such crossings.

Other safety issues will also be addressed by our host Svr Fredén, MRO Chairman. MRO Is currently waging a similar battle to ourselves in the UK against the Swedish government's attempts to impose inappropriately complex and stringent regulations on heritage railways (dare one talk about a Europe-wide 'safety overkill' ?....)

More encouragingly, following an initial brief discussion at last year's AGM in Birmingham, it is hoped to move further towards setting-up joint funding for research projects which will benefit railways In several different countries. We expect to get a progress report from Dipl Phys Reinhard Serchinger on his project to confirm scientifically that firebox ashes have environmentally positive qualities and should therefore be regarded as 'green' (rather than 'black' or 'grey' !)

After the working sessions, our Swedish hosts are naturally keen that delegates should have a chance to see something of their country's heritage railways. At previous FEDECRAIL conferences, we have been able to do this by adding a couple of days of intensive forays from the conference city by rail and bus. Sweden is Europe's second largest country and so the distances between individual lines and railway museums are very substantial and such an arrangement would not be practical.

Our hosts have found a truly spectacular solution to this problem - one of Sweden's main line preservation groups, the Kalmar Museum Railway Society has for many years operated its own complete train of veteran vehicles of the 1940s and 1950s on popular week-long excursions on the Swedish and Norwegian networks. The 'Kalmar Train' consists of sleeping cars, first-class 'individual armchair' day coaches, restaurant and bar cars, hauled always by at least two of its three restored electric locomotives, a Class 'Du 444' of 1938, a Class 'Da 888' of 1955 and a Class 'Da 941' of 1957. The overall atmosphere is of postwar traditional solid comfort rather than 'Orient Express' opulence.

In association with FEDECRAIL and MRO, the Kalmar Society is running the 'Scandinavian Midnight Sun Tour'. Starting from Stockholm, the tour will run right up across the Arctic Circle to the famous iron ore railway which runs across Into Norway to the Ice-free port of Narvik. The seven-night tour (evening of Sunday, 1 June 1997 to the morning of Sunday, 8 June) will include visits to the Swedish Railway Museum at Gävle, some railway workshops, several preserved railways and the iron ore mines at Kiruna (with possibly an underground tour). The return journey takes the tour train as far south as Sweden's second city, Gothenburg, where a sightseeing tour of the city will be made by historic trams from the Gothenburg Tramway museum.

Participation in both the 'Scandinavian Midnight Sun Tour' and the FEDECRAIL Conference is open to anyone (not just the 'voting card' delegates of FEDECRAIL's members). Despite the perception that Scandinavia is expensive for British visitors, we have succeeded In negotiating some very good prices, aided in part by some generous sponsorship.

For the tour, three alternative packages will be available covering travel, all visits and seven nights' accommodation (five nights' train and two nights' hotels). The 'Budget' package (three persons per compartment) costs SEK 3,870 (£336), the 'Standard' package (two persons per compartment) SEK 5,800 (£504) and the 'Premier' package (sole occupancy of compartment) SEK 11,000 (£956). Prices are subject to final adjustment once all operational costs have been confirmed but should not vary greatly from these figures. Sterling prices are shown for information and are based on an exchange rate of SEK 11.5 = £1. As we will be sharing the tour with some of Kalmar's regular Swedish customers, we need to have an estimate fairly quickly of the accommodation requirements for the international group. Bookings should therefore be be made as soon as possible, and definitely by 1 April.

Full details of both the tour and the conference may be obtained from the FEDECRAIL Conference Officer: Peter Ovenstone, 33 Palmerston Place, Edinburgh EH12 5AU. Tel: 0131 225 1486; Fax: (on phone request) 0131 225 1486.

Peter Ovenstone writes in his capacity as Conference Officer to FEDECRAIL, the European Federation of museum and tourist railways

Swedish railway preservation: former Byvalla-Långshyttens Railway 0-6-0T No 4 calls at Bärby station. Here passengers can change to a vintage bus which connects with a steam boat to the castle at Skokloster.
Andreas Wik

ADtranz

Dokument - *Document*
SPEAKER'S NOTES

ABB Daimler-Benz Transportation

Mottagare, deltagare - *Recipient, Participant*
FEDECRAIL

Informationskopia - *Information copy*

Godkänd - *Approved*
FÖK C Nordblom

Greeting to the FEDECRAIL conference, May 1997

1 Introduction

Adtranz Signal wishes to greet the FEDECRAIL conference who has choosen to have its conference in Stockholm now when it (ususally) is at its best!

As a leading manufacturer of advanced signalling systems Adtranz Signal wishes to emphasize the fact that a good knowledge of railway operations of the past is essential for driving the railway industry forward in a more competitative environment. There are heavy costs related to railway operation. By knowing our history, we will be able to analyse why a specific solution, either procedual or technical, has been selected to solve a problem. This knowledge and experience will guide us today when selecting new techniques that focus on solving future issues rather than mapping on existing technical solutions.

I would like to take the opportunity to explain how Adtranz´ signalling experience can contribute in increasing the competivness of the railway industry of today. However, our systems are modularised in a way enabling not only big but also small operators or infrastructure owners to benifit by using them.

Adtranz Signal has extensive experience in developing, engineering and installing advanced signalling and safety systems world-wide. The systems allow for increased train speeds and shorter headway between trains, improving capacity and cost effectiveness for railways and mass transit operators while ensuring safety and availability.

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The signalling group is part of the global Adtranz organisation, offering complete turnkey rail systems including rolling stock, infrastructure installation and maintenance services. Its world-wide presence enables the company to pool local and global resources to tailor the best rail solutions available.

Building a strong foundation of trust and reliability, the signal group always fosters long-term partnerships with its customers and key suppliers. Open to sharing experiences and knowledge the group is committed to maintain opportunities for local companies and partners.

The Swedish part of Adtranz Signal dates back to 1915. The company belonged to the Ericsson communication group until 1989 when it became part of ABB. The rail transportation activities within ABB and Daimler-Benz were merged on 1 January 1996.

Many of the signalling systems marketed by Adtranz world wide have their roots in the Swedish soil. Progressive and knowledgeable customers with high demands regarding safety, reliability and functionality have driven Adtranz to its present position.

Today, Adtranz Signal is at the forefront of technical development. In pioneering centralised traffic control, electronic interlocking, intermittent automatic train protection and radio signalling, Adtranz has consistently pushed the future of rail transportation forward by producing innovative solutions.

Adtranz signalling stands for integrated and total system solutions, providing customers with cost-efficient solutions to introduce higher train speeds, improve traffic capacity and network availability.

Combining the best expertise and know-how available, the signal group draws on indigenous research as well as the resources of its parent companies ABB and Daimler-Benz to push towards a new era in rail transportation.

Adtranz invites its customers to join the future and a partnership in building rail transportation solutions that provide faster, cleaner and safer transport for millions of people.

2 Signalling the future of rail transport

Adtranz Signal offers the most modern signalling technology to shape the future of rail transportation. The systems allow for increased train speeds and shorter headway between trains, improving capacity and cost effectiveness for railways and mass transit operators while ensuring safety and network availability.

2.1 Traffic management system.

The Ebicos traffic management system is suitable for controlling local traffic areas as well as complex suburban or mainline routes with a large number of stations and trains. Ebicos is also fully developed for controlling and supervising heavily used lines with mixed traffic that may include high-speed, express, commuter and goods trains.

Adtranz delivered the first CTC- system in Sweden already in 1938. The CTC systems delivered on a national basis starting in the late fifties has led to enormous savings. The investment was paid back within less than a year, mainly by reduction in personnel. Presently there are 11 management centres controlling the Swedish train traffic. They will be reduced to only 8 in the future.Postponing expensive double and quadruple tracking has later also added to the savings. As you will see on the coming round trip, most railways are single track in Sweden. You will also note that multiple track lines have bi-directional signalling. Since 1970 our systems are computerised. We are now busy in delivering the fifth generation to the traffic management centres in Hallsberg and Gävle.

A single signalman (or nowadays equally often signalwoman) can control one or more traffic areas, allowing considerable flexibility in staffing the operation centre when traffic loads vary. Workstation panels displaying detailed views allow the signalman to zoom in on traffic developments and equipment of particular interest.

Each train has a unique identity in the system. It is thus always possible to locate a particular train, or to identify a train approaching a certain signal. This is essential in a complicated mixed traffic system where high-speed trains need to overtake slower trains.

The traffic plan can include a number of alternate train routes, one of which will automatically be chosen according to pre-programmed conditions. Traffic plans can also be individually set and adjusted by the signalman for each train. In one of the biggest Ebicos systems, the traffic management here in Stockholm, 33 000 out of 36 000 daily train movements are generated automatically. This relieves the signalman from routine duties and enables him to focus on solving problems rather than pushing buttons.

A train route is established by defining an entry and exit signal, and a pre-test routine automatically establishes if the chosen route is clear for passage. If a particular route is occupied, the system will automatically place the train movement on a waiting list and dispatch the train as soon as the route is clear. By route splitting, proceed aspects can be displayed to the driver as soon as a section is free to enter even though the complete route asked for is not available. Ebicos is adaptive to different types of interlockings meaning that regardless of interlocking functionality the signalman will have a uniform interface which means that it is not necessary to have the same functionality on all interlockings in the area. Implementing Ebicos is not necessarily linked to investments in new interlockings.

2.2 Electronic interlockings.

Pioneering computerised interlockings in 1978, Adtranz has installed in the order of 150 fully computerised interlockings in Denmark, Finland, Norway, Poland, Spain and Sweden, totally controlling approximately 15 000 way side objects e.g. signals and points. Adtranz Signal is now launching the fourth generation of high-capacity and fail-safe interlocking systems. We have received more than 40 orders for the new Ebilock 950, all of them outside Sweden so far.

Ebilock is a cost-effective and flexible electronic interlocking that handles the logical and safety related connections between signals, points, trains and level crossings in the rail system. Ebilock is now designed to allow for both geographical and free-wired interlocking. This makes it competitive for both large integrated interlocking systems for an entire country and small stand alone interlocking. The basic safety principle is diversified safe software which is developed and certified according to the latest CENELEC standards in Europe. However, from availability point of view the interlocking is configured in the manner of "duplicated hot stand by" reducing down time to zero.

Adtranz Signal is probably the world leader in computerised interlockings. The powerful graphic engineering tools and test programs, used to adapt the interlocking to each station, are a key competitive advantage as it introduces industrial methods for application design, production and validation. The advantage for the railway industry with Adtranz interlockings is the short lead time. We can install and commission a new Ebilock 6 - 9 months from order. Rebuilding stations is also facilitated as all changes can be safely simulated and validated in-house, thus reducing installation time. The Swedish National Rail Administration, closely co-operating with Adtranz, recently redesigned, modernised and upgraded two interlockings at Hallsberg, one of the largest junction stations in Europe with approximately 300 points, without interrupting normal traffic. The speed restrictions given to trains were only dependant on track geometry and not due to insufficient safety.

During your round trip you will pass by many Ebilocks. You may discover them as container like green buildings if they are not disguised by red wooden panels with white corners. They are delivered pr-wired and pre-tested to site as "virtual plug and play systems".

2.3 Automatic train protection.

Ebicab, the automatic train protection system, developed and marketed by Adtranz Signal is the most installed intermittent ATP-system in the world. Pioneering an electronic and intermittent ATP-system in 1978, the company has installed its Ebicab system in Sweden, Norway, Finland, Poland, France, Portugal, Bulgaria, Australia, China, Taiwan and recently signed a contract with RENFE in Spain. It may be interesting to know that Adtranz has delivered in the order of 60 000 balises to the Swedish network out of our total production of some 250 000. Take the opportunity to study the ATP-system during your round trip. The locomotive you are travelling with is equipped with ATP.

Ebicab will raise traffic capacity and reduce headway as drivers receive more updated and precise information on speed limits and target points. The continuous speed-supervision considerably reduces the human factor as a cause of accidents. A modern ATP-system constitutes one of the main prerequisites for introducing higher speeds and increasing line capacity.

The ATP system intervenes with audible and visual warning signals if the driver exceeds the highest permissible speed. When the speed is reduced to within acceptable limits, ATP returns to being transparent and supervisory. However, if the driver fails to reduce speed, Ebicab intervenes and automatically brakes the train.

Ebicab consists of encoders installed along the track, balises on the track and onboard train equipment. The encoders translate information from signals, level crossing and interlockings into coded safety telegrams that are transmitted to balises via a serial link. The balise is powered by an antenna, mounted under the passing train, that also receives the telegram and forwards it to the onboard computer for decoding.

The vehicle computer continuously calculates braking curves, based on the train's braking capability, and the maximum permitted speed of the train. It also takes into account factors such as signal aspect, gradients, track quality, brake characteristics and other conditions. Maximum speed and speed restriction at the next signal are also displayed on the driver's panel. The high functionality regarding supervision of different types of targets enables each individual train to travel as fast as safely possible. High speed trains with high performing brakes will be supervised differently from low speed heavy freight trains with poor brakes. This functionality increases the capacity on the line as the signal system supports all kinds of trains and is not limited to consider all trains as "worst case trains".

Ebicab also considers the dynamical properties of the train. High or low axle loads, smooth riding bogies or rigid frame bogies all have their impact on the track. Ebicab matches the train properties with the capability of the track on each part of the line. This gives the advantage that light trains will not suffer the restrictions needed for a heavy train on a weak track, e.g. bridge.

It is not only speed boards or signals that are supervised in Ebilock. Landslide and level crossings are also supervised. In the latter case trains are informed about the level crossing in advance. The train will by default calculate a brake curve to stop before the level crossing. If the crossing is clear and barriers are down the level crossing will cancel the restriction and the train can uninterrupted continue traveling at line speed. This is a high safety advantage in Ebicab as all level crossings need not be removed before introducing high speed train operation.

I will conclude the praising of Ebicab with another function, the train identity sub-system. The train can identify itself by transmitting information to the track. This information can be used for different purposes. E.g. inform the train describer system about what train is approaching a station. In Sweden high speed trains are identified so level crossings are tripped advance of the tripping point for normal trains. This will keep motorists happy as level crossing down time may be reduced for the majority of train passages.

The powerful Ebicab system is the template for the European Train Control System, ETCS, the common European safety system that will allow trains to pass borders without exchanging drivers or locomotives regardless of national signal systems. This is a reality today between Sweden and Norway and it will be the future in the rest of Europe as well.

2.4 Radio signalling.

In close co-operation with the Swedish National Rail Administration, Adtranz Signal has developed a new system for radio signalling that could mean a renaissance for regional and secondary lines.

Position reports are sent from the train to the central radioblock computer via radio base stations. This is a very cost-effective alternative to today's remote control system based on track circuit technology. Optical signalling, cables, signalmen and tokens at each station can be made obsolete. The radio signalling is based on proven fail-safe technology for automatic train protection, interlocking and digital radio communication.

The first radio signalling system was commissioned for commercial operation in May 1995 on the 115 km line between Linköping and Västervik on the Baltic coast. The system has since then been extended another 30 km.

The experience in radio signalling, automatic train protection and computerised interlocking is most valuable for Adtranz in building the future systems for Europe with focus on improving the competitiveness for the railway industry.

2.5 Automatic train operation.

Adtranz vast experience of train operation has led to the introduction of Ebicruise. A system that automatically drives metro trains and is subject to supervision by the fail-safe automatic train protection system. Adtranz Signal has delivered the Ebicruise system to metro lines in Seoul, South Korea and Bilbao, Spain. It will also be installed in Pusan, South Korea.

The automatic train operation relieves the driver of routine tasks. The system is in the driver's seat, guaranteeing even and comfortable speed profiles and shorter headway. Ebicruise allows the traffic management to have full control of the metro line at all times. Trains will leave and depart on time, providing for improved traffic capacity and increased passenger flow. Uncomfortable and unnecessary braking caused by trains overriding the speed limit is eliminated.

Ebicruise can be adapted for use on main line, commuter and goods trains. Commuter traffic, with a driving profile similar to metros, can increase capacity and reduce time-wasting movements to a minimum with the ATO-system. The guard can be abolished or attend to passenger needs.

Energy-efficiency is at the core of the Ebicruise main line application. Optimising energy efficient train speeds and braking will reduce energy consumption by approximately 5 to 15 per cent. Heavy duty goods trains use enormous amounts of energy when braking and starting. ATO can provide the goods trains with an optimal speed profile that reduces energy wasting movements, and wear and tear on rolling stock to a minimum.

2.6 Ebiswitch.

For many railways, point machine failure is the single biggest contributor to train delays. Today the railway industry still uses point machines that were designed by our grand fathers. Adtranz has now designed a new generation of point machines in close co-operation with the infrastructure owners in Europe. during your roud trip you may pass the two first installations in Sweden.

The new generation of Adtranz point machine, Ebiswitch, is fully sleeper integrated which allows mechanical maintenance in the entire turnout and makes track maintenance very efficient and economical. Thanks to its modular design, fast on-site servicing and maintenance can be performed, without disturbing the traffic. The down time for replacing any module in the point machine is only about 15 minutes.

Ebiswitch is designed to increase availability of the traffic network and for more economical maintenance. The stroke length of the switch blade opening is adjustable, which means that Ebiswitch can be installed anywhere along the blade. The point machine can be used in short turnouts with one machine and in long turnouts with several machines. The adjustable stroke length reduces the number of types of point machines and spare parts to be stocked.

3 Summary

Adtranz Signal can optimise network performance and profitability by offering open, flexible, modern and innovative signalling and safety systems that increase traffic capacity, speed and reliability. By pooling local resources, we develop these innovative solutions in close partnership with customers, suppliers and clients worldwide.

Thank you for your attention.

ADtranz

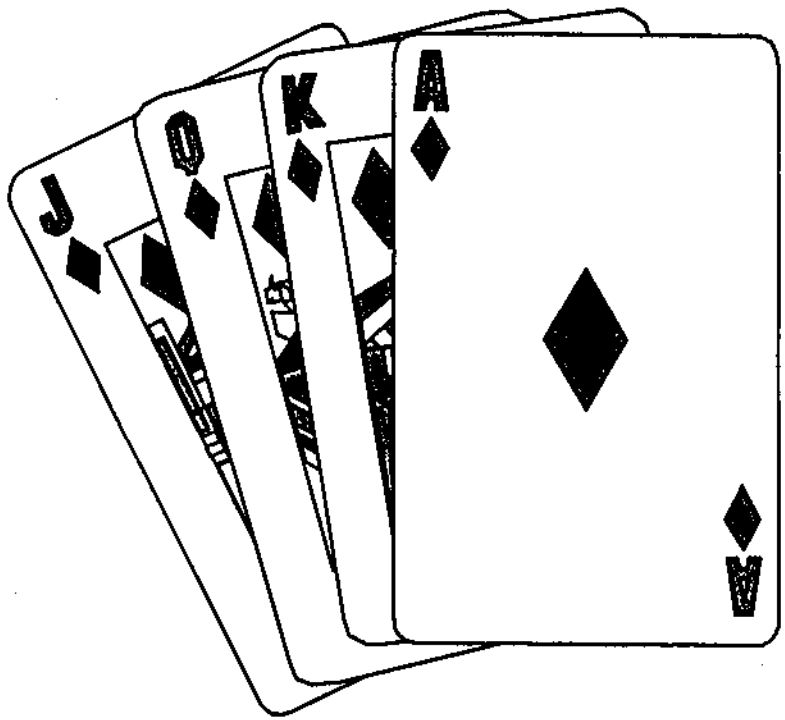
Signal

ADtranz

To operate a railway there are four types of costs

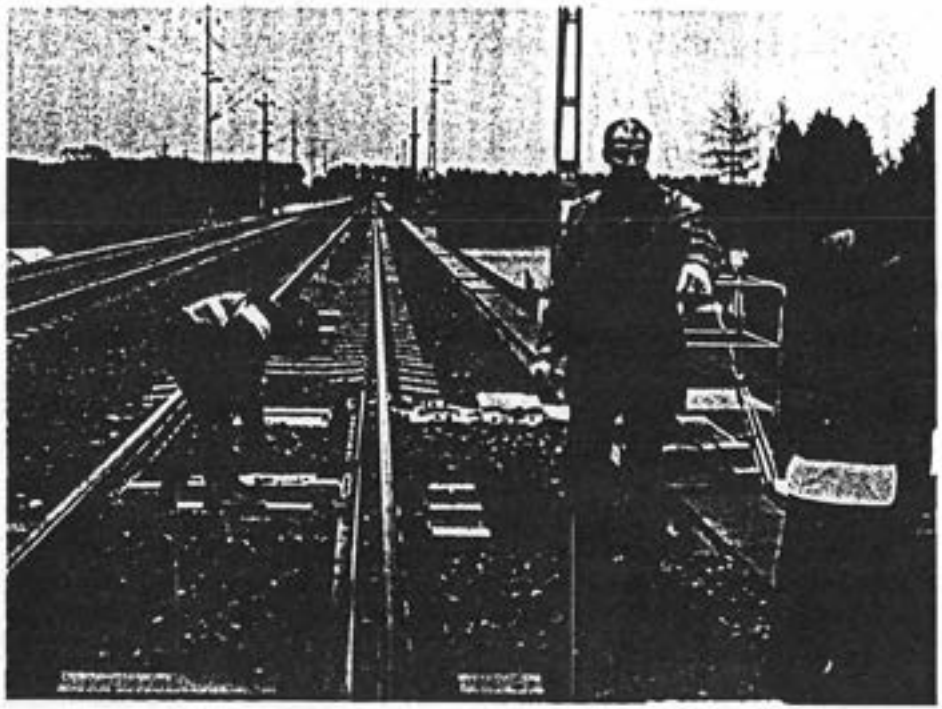
- cost of staff
- cost of rolling stock
- cost of fixed installations
- cost of tradition

"The last one is the biggest"



ADtranz

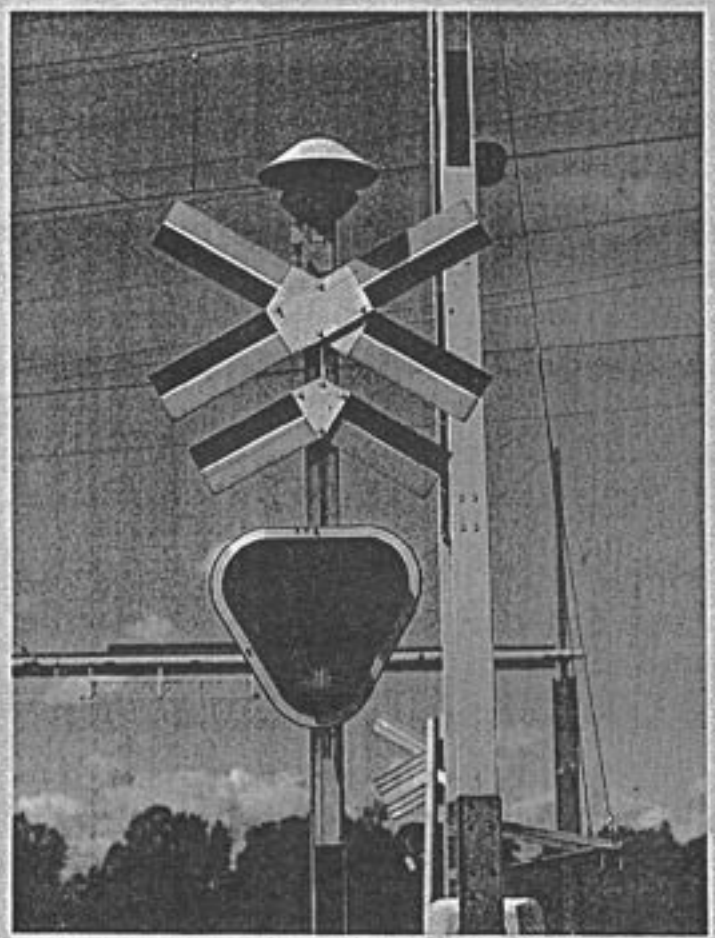
Total signalling systems



- design
- adaptation of products
- installation
- commissioning

ABB Daimler-Benz Transportation 96-02 No 11E

Complete product range

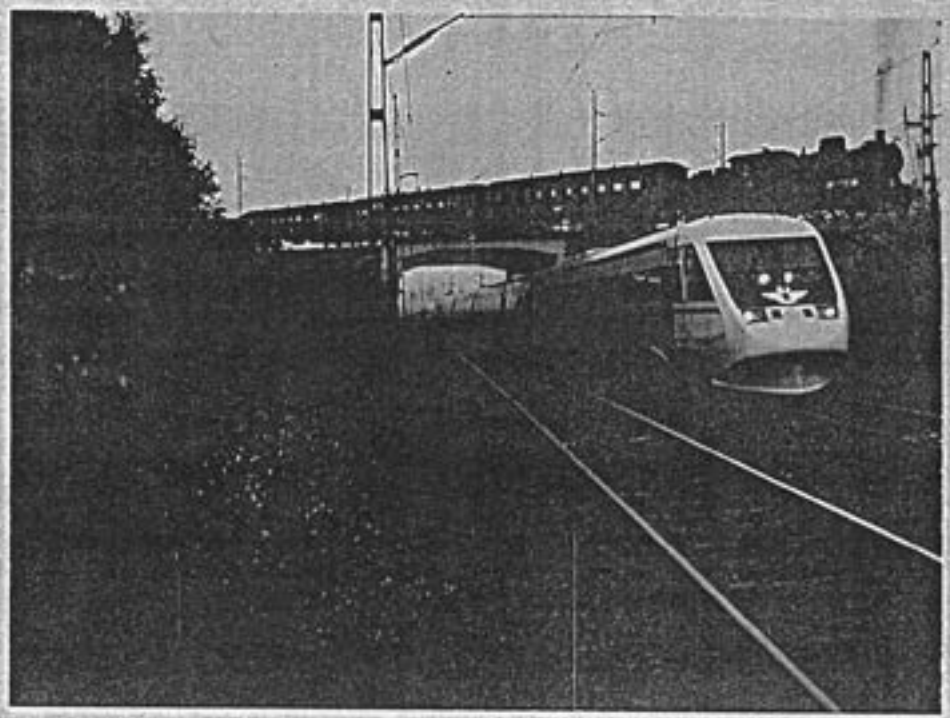


- integrated operation control systems
- electronic safety systems
- transmission
- wayside equipment
- auxiliaries

ABB Daimler-Benz Transportation 96-02 No 14E

ADtranz

80 years of experience



- founded in 1915
- signalling solutions globally
- complete product range

ABB Daimler-Benz Transportation 96-02 No 3E

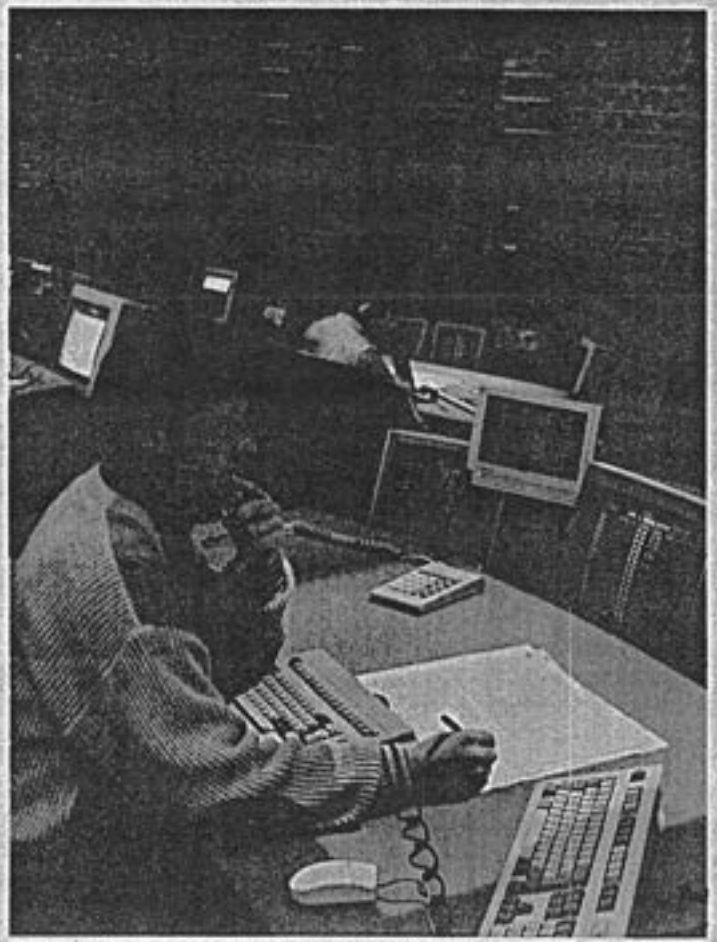
ADtranz

Technical pioneers

- centralised traffic control 1937
- electronic interlocking 1978
- intermittent automatic train protection 1978
- Eurobalise 1995

ABB Daimler-Benz Transportation 96-02 No 4E

Integrated operation control system



- *controls and supervises main lines, urban traffic and catenary network*
- helps traffic operators optimise traffic flow
- automatic routing and conflict resolution
- open system

ABB Daimler-Benz Transportation 96-02 No 15E

ADtranz

Electronic safety systems

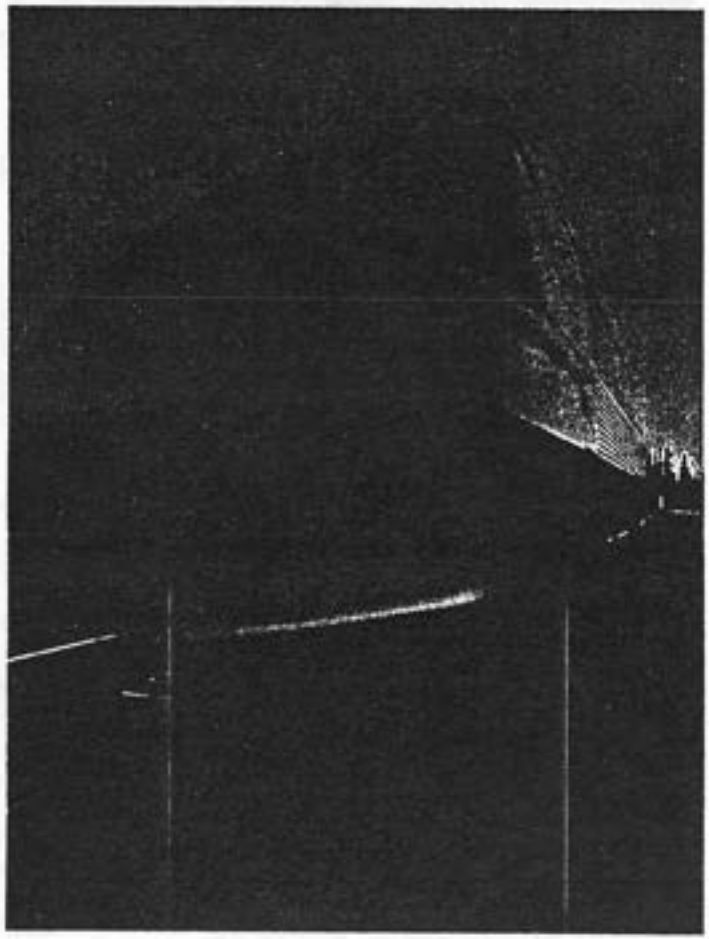
Interlockings

- establishes lock and release of train routes

- geographic or free-wired interlockings
- two different and concurrent programs in each computer
- high availability
- system and design tools adaptable to customer requirements

ABB Daimler-Benz Transportation 96-02 No 17E

Electronic safety systems



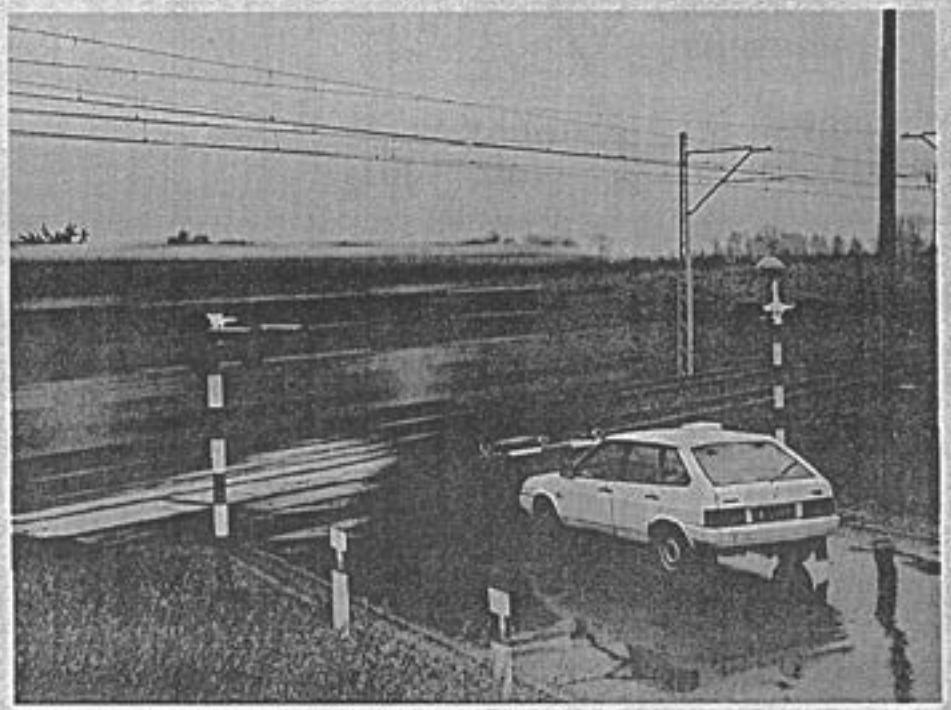
Automatic train protection

- *supervises and controls train speeds*

- receives and transmits information to passing trains
- replaces optical signalling
- most installed intermittent ATP in the world

ABB Daimler-Benz Transportation 96-02 No 18E

Level crossing protection



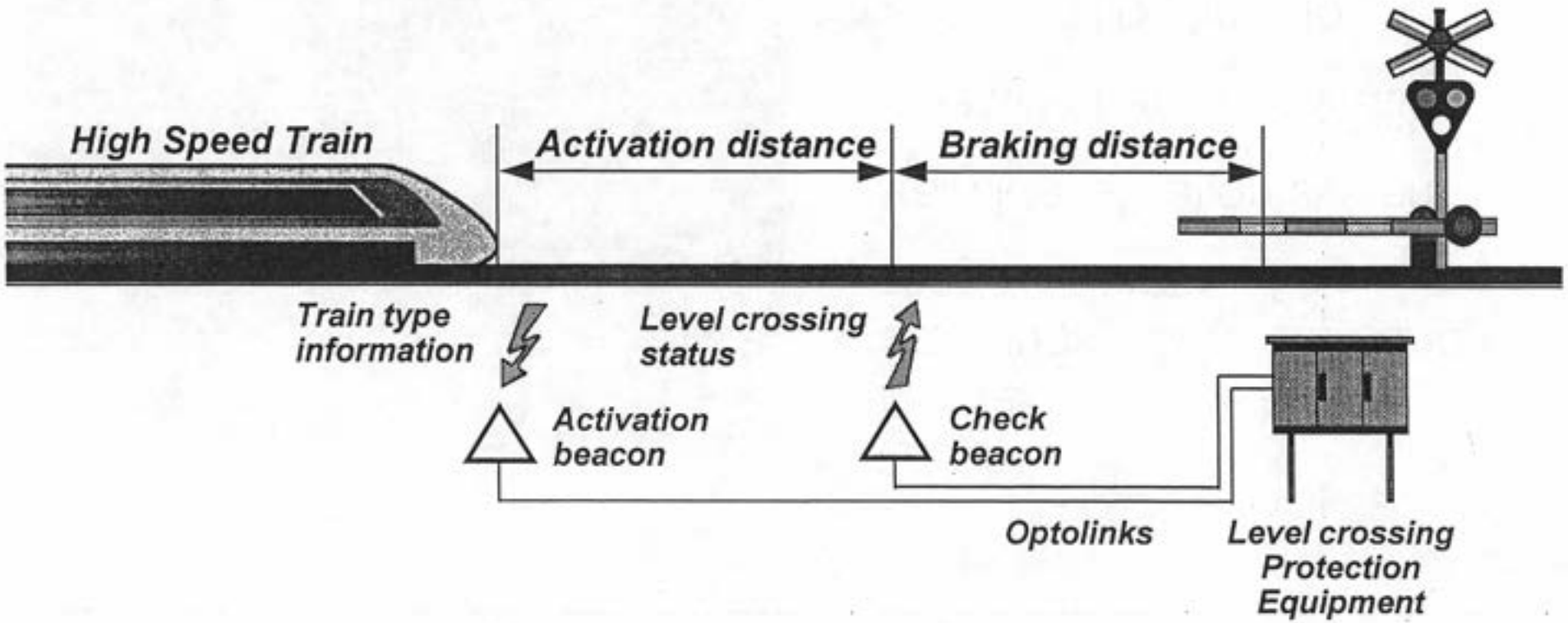
- *increases safety at crossings where train and road traffic meet*

- train identification system
- selective barrier operation
- short waiting time for motorists

ABB Daimler-Benz Transportation 96-02 No 24E

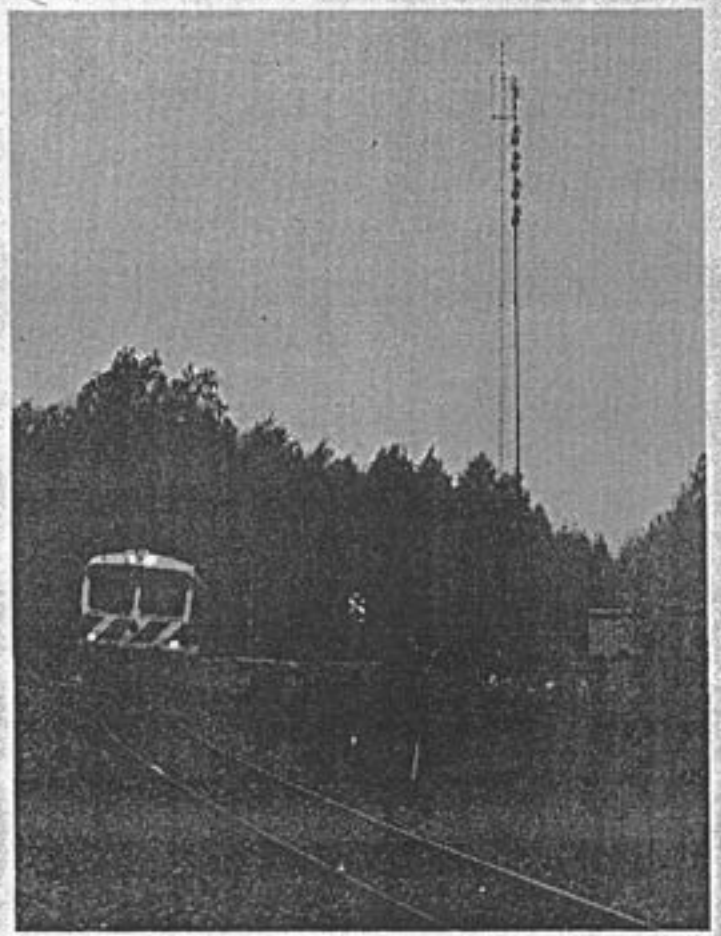
ADtranz

Level crossing control for High Speed Trains



ADtranz

Radio signalling



- controls traffic and trains via radio

- raises profitability on low density routes
- raises traffic capacity
- reduces investment and maintenance costs
- provides rationalisation possibilities

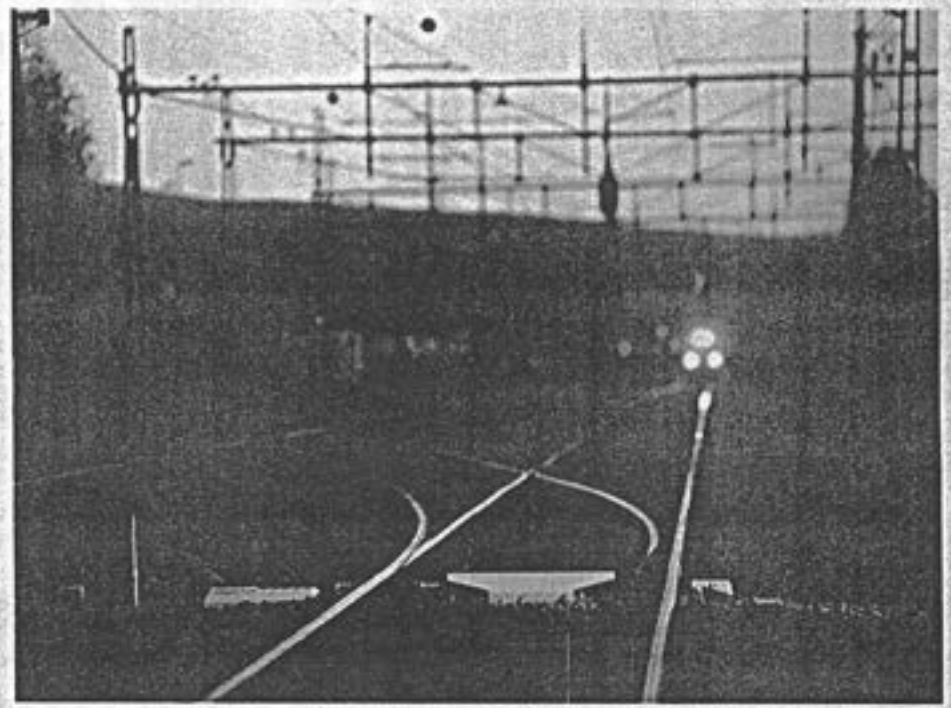
ABB Daimler-Benz Transportation 96-02 No 21E

Automatic train operation

- *drives trains automatically*
- comfortable acceleration and braking
- reduces energy consumption and wear on rolling stock and track
- allows for maximum speed and traffic capacity

ABB Daimler-Benz Transportation 96-02 No 19E

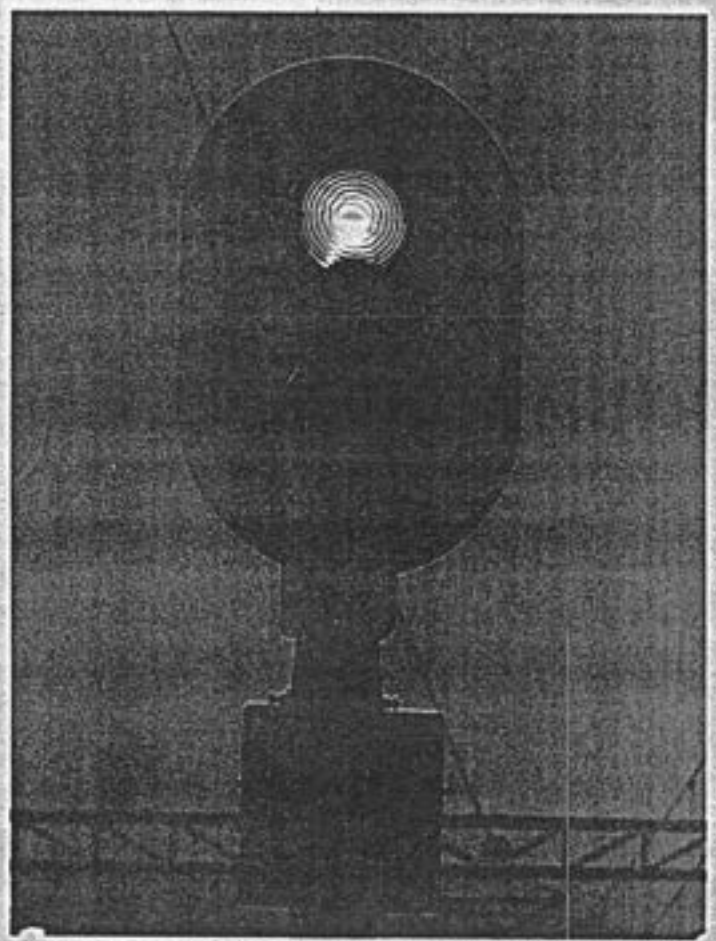
Wayside equipment



- point machines
- detectors
- signals
- track circuits
- relays
- level crossing protection

ABB Daimler-Benz Transportation 96-02 No 23E

Investing in the future



- customer focus
- pooling local and global resources
- total system supplier

ABB Daimler-Benz Transportation 96-02 No 2E

The Management of Risk at Level Crossings

Introduction

Level Crossings are a familiar interface that road users often have with the railway. If you are a motorist or a pedestrian who regularly crosses one on your journey to work I would be surprised if you considered it in any different way to say a pedestrian crossing or a road traffic light. It is just another potential hazard.

As a passenger on a train I would not expect you to even think about a level crossing's safety, you would just take it for granted.

But having said this, the safety of level crossings in Britain and throughout Europe can be a can be a very emotive and often the subject of a 'political football'. If an accident occurs at one, the local newspaper headline is invariably 'train hits car at level crossing' and not 'car hits train'! If Railtrack want to modernise an old fashioned manned gated type and replace it by an automatic one to reduce costs (and incidentally delays to motorists) then there will be a fairly predictable initial public reaction against. Peoples' concerns centre around that there won't be a crossing keeper physically present to ensure safety, barriers are too flimsy to stop cars going on to the crossing (so are wooden gates if the vehicle hits them at moderate or higher speeds) and children can get onto the crossing and be killed. All this, despite the fact that there is no physical barrier to prevent a motorist driving past a red traffic light on the roads, no physical barrier to stop you driving straight out onto a busy main road from a country lane, nor a fence along a pavement to prevent a child running out into a road.

In this paper I intend to explain how Railtrack has studied and measured the risks at the different types of the level crossings in the UK, and then how we are seeking to control the risks. As over 95% of all accidents at level crossings in Britain are caused by bad behaviour of the level crossing user, you will not be surprised to learn that improving this behaviour is crucial to our strategy.

History

Railtrack currently has about 8,700 level crossings, which can be broadly categorised into the following types.

Protected by Signals		Unprotected	
Automatic			
Automatic Half Barriers (AHB)	456	User Worked with Warning Lights (MWL)	129
Automatic Barriers (ABCL) Controlled Locally	31	User Worked Gates (UWC) or barriers	3037
Automatic Open (AOCL) Controlled Locally	151	UWC with telephones (UWC/T)	1275
Manned			
Manned Gated (MG)	320	Occupational Crossings (OC)	61
Manned Barrier with CCTV (MCB/TV)	283	Footpath Crossings (FP)	2676
Manned Barriers (MCB)	311		

The following slides show some of these types. You will notice that it is important that each type presents the same appearance to the user, so that they will recognise it and know how it should be used.

In the 19th Century when labour was cheap, level crossings were frequently built to avoid the capital cost of a bridge, and there was very little change in their number until the late 1950s and early 1960s. Change came about with rising cost of labour, the introduction of multiple aspect signalling and increasing amount of road traffic being delayed at the traditional crossing. The latter point is interesting as on average a gated level crossing worked by a keeper takes about a minute to close, whereas it is only 27 seconds before a train arrives at an automatic crossing after the crossing close sequence has been initiated. Similarly an AHB opens to road traffic as soon as the train has passed, whereas at the traditional level crossing it takes up to a further minute before the crossing is open. The conclusion is that a motorist suffers less delay at an automatic level crossing.

Safety Record

But what is the safety record of level crossings in Great Britain compared to Europe? The table below shows the latest data that is available from the UIC and refers to 1994, except where shown.

Country	1990	1994
	No. of Crossings	Fatalities/1,000 Crossings
Netherlands	3,309	16.4 (1)
Belgium	2,720	6.2
West Germany	20,267	5.4
Denmark	1,933	1.6 (2)
France	24,338	1.0
Britain	9338	1.5

(1) 1990 figures as 1994 is not available
(2) 1993 figures as 1994 is not available

Based on historical records it can be seen that British level crossings have an excellent overall safety record. This probably reflects the very significant sums of money that have been spent to maintain or improve them. However Railtrack has only limited investment monies available which must be spent to give the best value for money. That is why Railtrack's policy is to seek out those crossings which carry higher risks and develop risk control strategies for them, not to make general safety improvements across all types. I will return to this point later.

Fig. 1 below shows the number of fatalities, (excluding suicides) that have occurred at all types of level crossings in Great Britain since 1983.

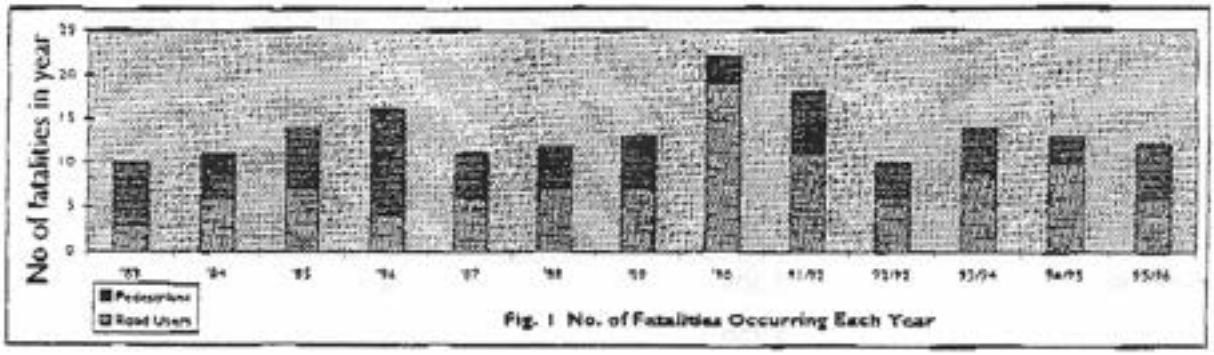
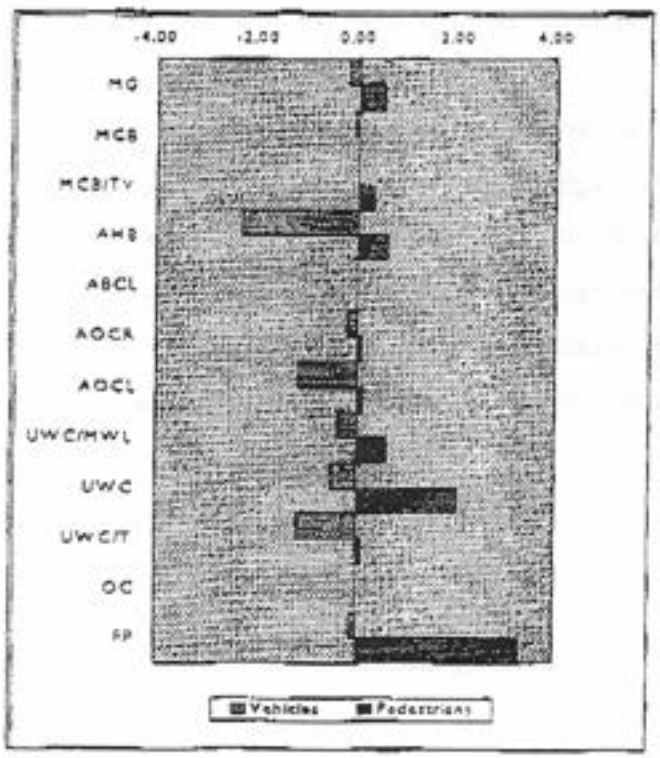
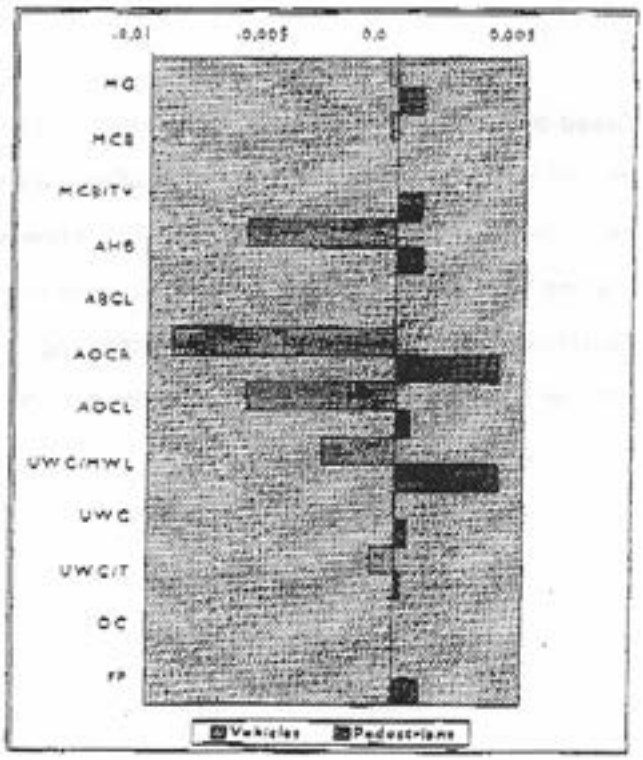


Fig. 1 No. of Fatalities Occurring Each Year

We can say that the average number of road vehicle occupant deaths have generally been more or less constant over the period, but there has been some increase in the number of pedestrian fatalities (primarily on footpaths). Even so these numbers are small in relation to the volume of users.



Actual Fatalities by Crossing Type



Accident Rate per Crossing

Fig. 2 shows that the average annual accident rates vary between the various crossing types

In addition, the annual fatality rates are greatest for vehicle occupants at automatic crossings, but for pedestrian users, most fatalities occur at unprotected crossings. If we focus a bit more on the automatic crossings and analyse the distribution of reported accidents or near misses amongst the population of AHBs - then we find the following:-

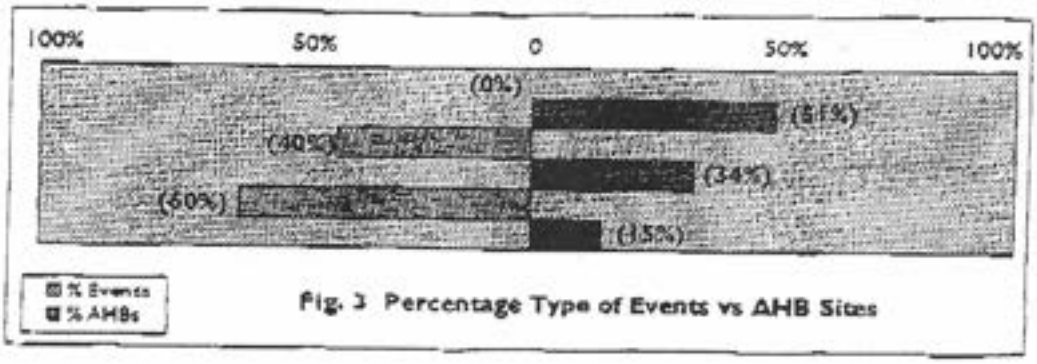


Fig. 3 Percentage Type of Events vs AHB Sites

The chart shows that many of these accidents were not evenly distributed across all AHBs. Many sites (51%) were free of accidents / incidents, one accident had occurred at 34% of sites, but 60% of incidents or accidents had occured at 15% (70 AHBs approx.) of the sites.

A similar situation is found for AOCL's as is shown in Fig. 4 below:

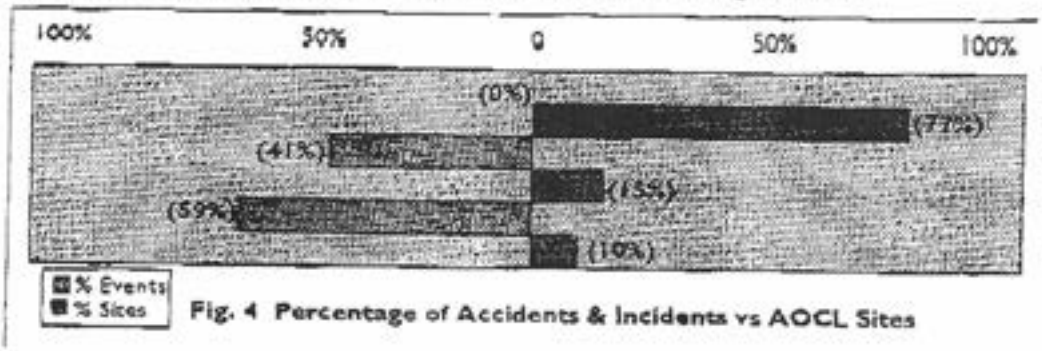


Fig. 4 Percentage of Accidents & Incidents vs AOCL Sites

The conclusion from Figs. 3 & 4 is that there must be some particular factors at certain AHBs and AOCLs which makes the user more likely to use them incorrectly. Further analysis of the data shows that the factors below can increase the likelihood of accidents.

- If the traffic movement (no. of vehicles x no. of trains) exceeds 30,000 movements per day for AHBs and 10,000 movements per day at AOCLs or ABCLs.
- Crossings on minor roads serving as an access to work places. At such locations users may be more inclined to take risks to arrive for work on time having left it too late, or similarly to leave quickly at the end of the day.
- Straight open roads allowing for high vehicle approach speeds. Motorists may leave braking too late (a significant proportion, 15% of all accidents involve the vehicle running into the side of the train).
- East / West level crossing orientation. The motorist may not see the crossing at certain times when the sun is low on the horizon.

The Concept of Risk

This historical data analysis is useful in that it helps us to identify what might be particular high risk crossings, but what do we mean by risk and what levels of risk are acceptable to society as a whole, and to the individual crossing user?

Risk is the probability that the event will occur and is expressed as fatalities per annum. It is calculated using the equation

$$RISK = Likelihood\ of\ Event \times Consequence$$

The likelihood is the number of times the event occurs per year, and the consequence the number of fatalities that occurred. In this context we express 10 major injuries or 200 minor injuries as being equivalent to one fatality.

Railtrack's Railway Safety Case states that the current benchmark level of risk for an individual passenger commuter, making 250 return trips per year, is about 10^{-5} fatalities per annum. Therefore for every 50 million passenger journeys we could expect one fatality.

Is this acceptable to that individual, or to society as a whole? Would we be prepared to pay higher fares or taxes to reduce the risk still further?

Risk Tolerability

The tolerability of risk is different for different type of user

Road Vehicle Occupant
Pedestrian
Train Passengers
Railway Workforce

and will be affected by their perception of the degree to which they control their risk exposure.

In 1992 the Royal Society of Britain summarised their views of regarding risk perception and acceptability in the publication "Risk Analysis, Perception and Management". They concluded:-

- Arriving at consensus decisions over the question of acceptable risks in society is not a simple matter and added that there can be no single all purpose number that expresses the acceptable risk for society.
- The report refers to the criticism of traditional approach to risk acceptability by Sir Frank Leyfield, Chairman of the Sizewell B Nuclear Plant Inquiry (1985) who proposed that *tolerability* rather than *acceptability* better reflects the reluctance with which individuals will undertake hazardous activities, particularly those involving the direct possibility of death or injury.

Subsequently the Health & Safety Executive (HSE), a Regulatory Body appointed on behalf of the UK Government, published their definition of tolerable risk in 1988 and developed their proposals based on the "As Low as Reasonably Practicable" (ALARP) principle.

The HSE state that "tolerability does not mean acceptability. It refers to the willingness to live with a risk to secure certain benefits and in the confidence that it is properly controlled. To tolerate a risk means that we do not regard it as negligible or something we might ignore, but rather as something we need to keep under review and reduce still further if and as we can".

In contrast to tolerable risks there will be those which will be completely *intolerable* to society in general, and to the individual in particular. The range between is known as the ALARP region. This can be illustrated by the ALARP triangle in Fig. 5 below:

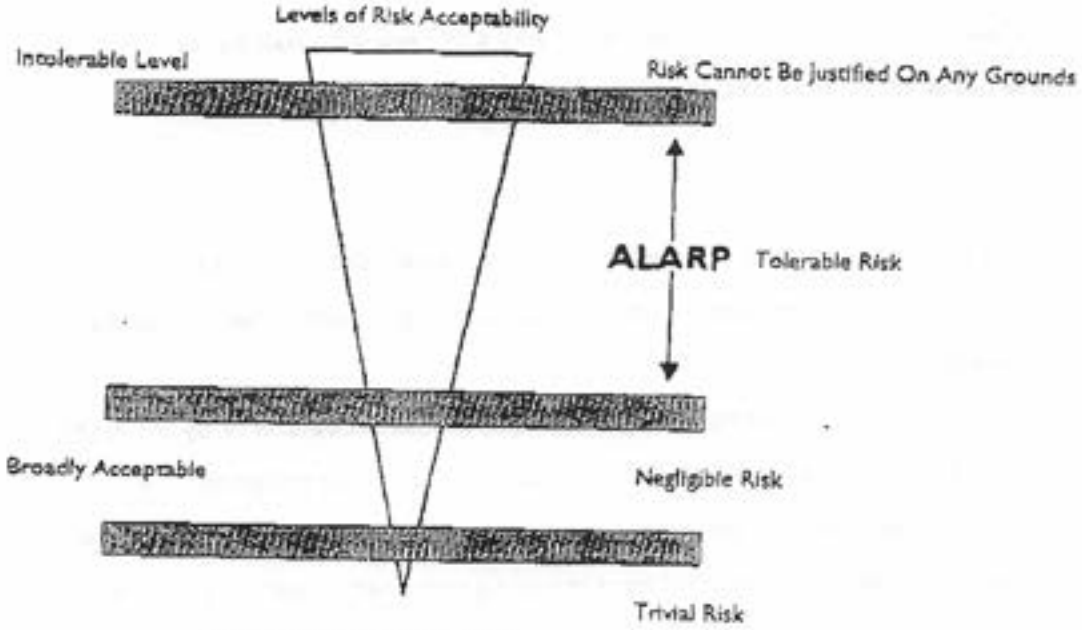


Fig. 5 ALARP Triangle

The arrow pointing downwards is intended to show that actions must always be taken to reduce the risk towards the broadly acceptable level. If a measured risk level is over the intolerable level then action must be taken, regardless of cost, to reduce the risks below the intolerable level.

Within the ALARP region then action should be taken to reduce risks, unless this would be impractical, due to the cost of the action proposed being grossly disproportionate to the improvement gained. Thus if we imagine a pair of scales and put the cost of reducing the risk on one pan and place the benefit on the other, as in the diagram below, then in this particular case the investment should be carried out to reduce risks still further.

Fig. 6 Comparison of Risks and Benefits

If however the situation was round the other way and there was a significant imbalance between costs compared to the benefits to reduce the risk, then to take the proposed action is not justified. In British law this principle is known as the test of reasonable practicability.

Plainly if the measured risk level is towards the upper limit of the ALARP region then greater expense to reduce the risk is justified, compared to if the risk was towards the broadly acceptable region.

Below the broadly acceptable region then it is very unlikely that any action can be justified to reduce the risks still further.

Risk Target Levels

Now that I have explained the ALARP principle, the key question is at what levels should the risk bands be set at? Once this has been done, and we have measured the risks, then we will be able to use the ALARP principle in order to judge whether the cost of making particular improvements are justified.

Many studies have shown that the individual's perception of risk affects the extent to which it is tolerable. In particular the following factors have to be considered:-

- The degree of risk control that an individual can exercise. For example, most of us are happy to drive a car on the road instead of taking the train, which has a much lower individual passenger risk level, because we feel as a driver we are in control of the risks and in many cases it is more convenient.
- The extent of impact if an accident occurs. A risk is more tolerable if only a single casualty is likely, less tolerable if many are involved. A related factor is that if young children are involved the risk is perceived to be much greater and less acceptable.
- Accidental or avoidable. If the exposure was genuinely accidental it is perceived as more tolerable than if the root cause was an avoidable failure either of equipment, or of not following a proper procedure.
- Voluntary. A risk exposure is more tolerable arising from a voluntary act. Thus a rail worker would be expected to accept a higher risk of injury than a member of the public using a level crossing.

In particular so far as level crossings are concerned we can illustrate these differing risk perceptions as follows:-

- The degree of control of risk. A motorist approaching the crossing has much more control than a passenger being carried in an approaching train. Therefore he/she would be prepared to accept a higher risk than the train passenger.
- The extent of impact if an accident occurs. A collision between a train and a pedestrian is likely to seriously injure the pedestrian. If the collision is with an articulated lorry, the train may derail and fatally injure many passengers.
- Accidental or avoidable. A collision in fog might be considered accidental and therefore a higher risk is more tolerable than one due to failure of the crossing light or the barrier is likely to be less tolerable.
- Voluntary. A pedestrian who chooses to use the crossing rather than a nearby footbridge is voluntarily tolerating exposure, whereas a person who must use the crossing to get home has no option and is involuntarily exposed.

Also in the context of level crossings, passengers who have paid for their journey can expect the Train Operating Company and Railtrack to exercise a duty of care and limit their risk exposure. Also road vehicle and pedestrian users who use the crossing as a convenience might expect their exposure to be no greater then for motoring / walking in general.

In conclusion therefore the tolerability of exposure to risk must take into account both the benefit derived from the exposure as well as the perception factors discussed previously. Railtrack's Railway Safety Case gives the following criteria to form the "boundaries" of the ALARP principle for assessing the acceptability of safety performance. The figures shown are risk of fatality per year.

	Upper Limit of Tolerability	Broadly Acceptable
Individual Employee Risk (All Trackside Staff)	10^{-3}	10^{-6}
Individual Passenger Risk (Commuter)	10^{-4}	10^{-6}
Individual Public Risk (Railway Neighbour)	10^{-4}	10^{-6}

The actual risks lie between the bands for each of the groups listed above, for example for an individual passenger it is about 10^{-5} per annum.

In the case of level crossings, the busiest ones tend to be automatic and Railtrack has set as a benchmark target a maximum risk level for such users (vehicle occupants and pedestrians) of 10^{-5} to be achieved by the year 2000. This figure was set taking into account that fact that road users are toferating an average fatality risk of 10^{-4} per year each time they set off in a car and pedestrians similarly tolerate a risk of about x 10^{-5} per year each time they walk along the road foot path. However they do have a high degree of control with regard to risk exposure at level crossings.

They can obey the rules of the road or can act recklessly, for example zigzag at an AHB and in this way become authors of their own misfortune. They are entitled though to expect the automatic crossing to function correctly, and for this reason Railtrack has set the target risk level an order of magnitude higher, at 10^{-5}, than the average road fatality risk.

Inserting these boundary limits into an ALARP triangle for level crossings we now have the following:-

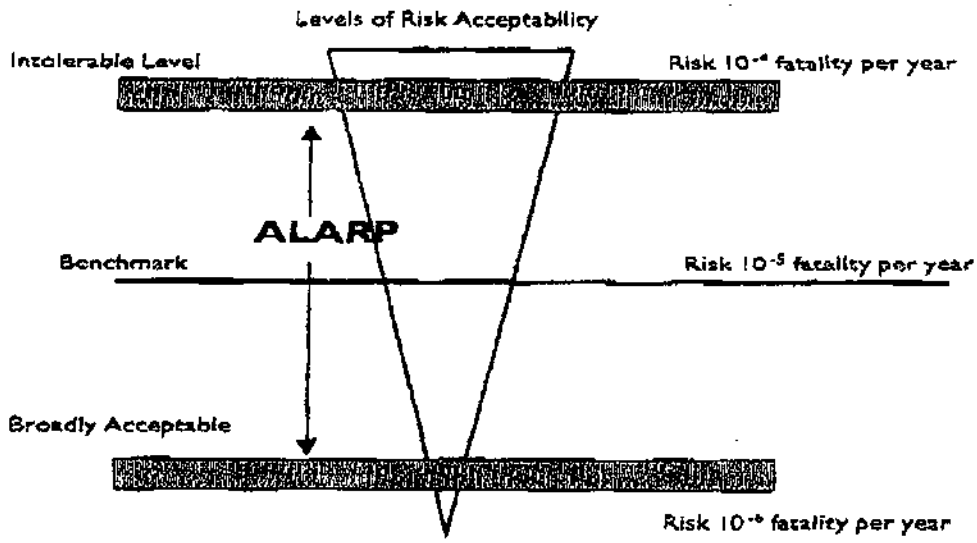


Fig. 7 Benchmark Maximum Risk of Fatality for Users of Automatic Crossings

The Railtrack Automatic Level Crossing Risk Model

In order to estimate what are the actual risk levels at particular automatic level crossings and how they change if the crossing parameters are altered, Railtrack appointed consultants, Arthur D Little Limited to develop a computer based risk model. The user enters the crossing type (e.g. AHB, AOCL etc.) and is then asked to supply key data (e.g. user utilisation for the crossing by vehicles / day and type, train utilisation and line speed). In the absence of site specific data, default values based on the Railtrack national average values for each crossing type are automatically entered by the programme. The model estimates the individual risk of fatality, together with the number of injuries (fatal, serious, minor) per year for particular crossings and compares these with the benchmark criteria.

The model has been validated by adding the predicted annual fatality rates for each automatic crossing in the country to give a Railtrack national figure, and comparing this with the actual historical rates. A good correlation was found which was statistically significant.

Checks were also carried out to confirm that the model was being correctly and consistently used by Railtrack Zones (Railtrack's front line operations are managed by 7 geographically based Zone Directors). Unfortunately the model is less reliable for estimating risks for the unprotected crossings, such as those worked by users serving private roads and footpath crossings. At such crossings, human factors in making a judgement as to whether to cross or not are much more important in determining the risk levels. There are a large number of such crossings (ca 6,000) and a diverse nature of population who use them. However in comparison to automatics they are only lightly used and have a generally good accident record, so Railtrack does not consider it practicable to undertake further studies into the human factors and associated error rates, in an attempt to model human behaviour. We are however co-operating with the HSE who have commissioned some work in this subject area.

Railtrack therefore only uses the computer model to evaluate risks at automatic level crossings.

Testing for Reasonable Practicability

I referred earlier to the test of reasonable practicability in the context of taking action to improve risks. Railtrack in its Railway Safety Case has adopted the value set for preventing a fatality (VPF) by the UK Department of Transport of £0.8M per equivalent life for road users at level crossings, and the higher value of £2.3M for rail passengers. The latter figure is higher because passengers are involuntary risk takers (i.e. they have no control over the risk they take in using the train, other than not travelling). These figures are used as a guideline only to Railtrack management decision taking.

In practice it had been found that during 1983 to 1994 on British Rail an average of 14 accidental fatalities per year occurred at level crossings, 95% of which were crossing users

and only 5% were rail passengers (all killed in one accident at Lockington in 1986). During this same period however, level crossing accidents accounted for just 1% (employees) and 2% (passengers) of all fatalities on the Railway. It follows therefore that level crossing improvements will have little effect upon the total risks on the railway for other than the occupants of road vehicles and pedestrians.

Therefore in evaluating safety benefits associated with level crossing improvement schemes, Railtrack uses the VPF of £0.8M. When evaluating an improvement scheme Railtrack first checks that the measured fatality risk level to a road vehicle occupant or pedestrian is not worse than 10^{-4} (the intolerable region). If it is then ALARP principle does not apply and immediate action must be taken to reduce the risks. Only 3 Railtrack automatic crossings have been found in this region and they are being carefully examined to determine what action should be taken. All the rest are in the ALARP region.

The next stage is to examine the particular risk levels. As discussed earlier Railtrack has set a benchmark target that all its automatic crossings by the year 2000 will either have a risk level to road vehicle occupants or pedestrians of 10^{-5} or better, or the risks will be made ALARP through the implementation of reasonably practicable schemes at the crossing. This may mean that the individual risk level at, for example a lightly used crossing is higher than 10^{-5}, but is still ALARP. The risk model is used to evaluate the risks associated with various alternative schemes to mitigate the risk, calculating the associated benefit using the VPF, and comparing the result with the cost of each scheme.

Risk Levels at Automatic Level Crossings

Fig. 8 shows the average risk levels for automatic crossings based on historical data from 1983 to 1992/3.

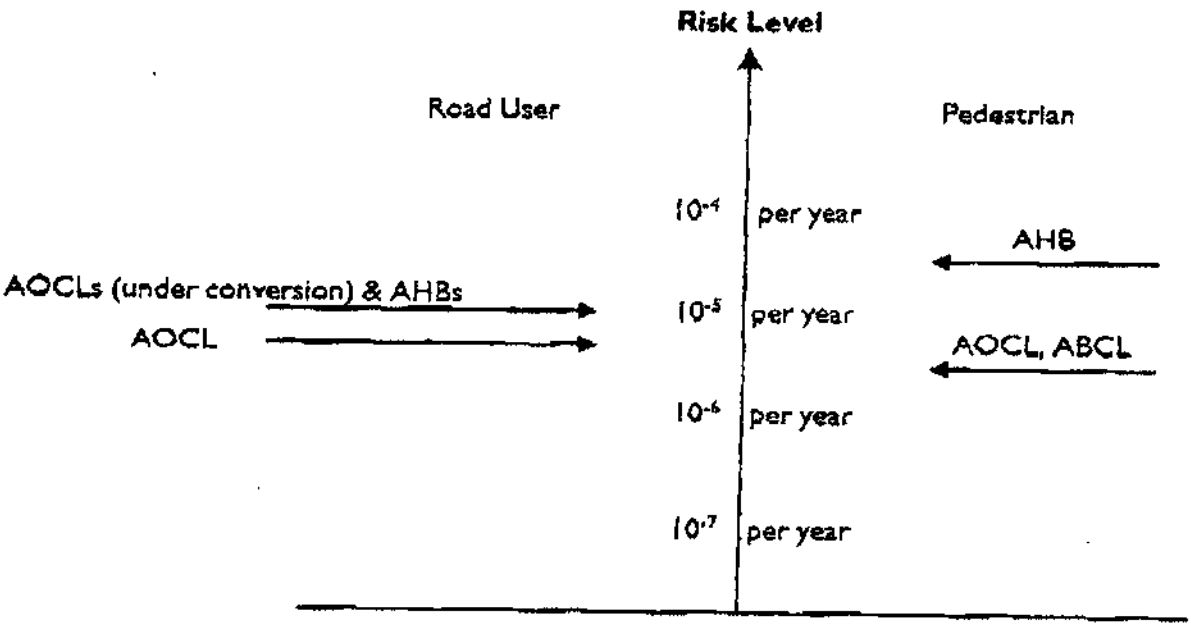


Fig. 8 Average Historical Risk Levels

To date we have used the risk model to evaluate the individual risks of fatality to individual vehicle occupants and pedestrians at virtually all of our automatic level crossings (638). At the present time 78% of them (498) have either risk levels which are better than the benchmark target of 10^{-5} fatalities per annum, or the actual risk level is already in the ALARP region because no reasonably practicable scheme can be implemented to further reduce the risk at that crossing.

We are continuing to examine risks at the remainder to check whether it is possible to undertake by the year 2000 any reasonably practicable schemes to reduce the risks still further. The model enables us to answer "what if" type questions through testing the associated risk levels associated with different schemes for various crossing types.

Reducing Risks

1. Improving the motorist's behaviour

Investigations have shown that poor behaviour by the user accounts for some 95% of all level crossing accidents. Typical examples involve leaving braking too late and skidding into the barrier or train, trying to jump the lights or zigzagging around the barriers of an AHB. The police have even captured, using a hidden camera, a double decker bus with passengers weaving round a barrier. The driver was subsequently prosecuted. As there is typically only 27 seconds between the time the crossing closure sequence is initiated and the arrival of the train at the crossing this really is dicing with death.

The UK Government's Transport and Road Research Laboratory undertook a video survey of drivers using an automatic level crossing and then subsequently interviewed those who had ignored the crossing lights (red runners!) to establish why. Asking drivers to give honest answers in such a situation might be considered as likely as I am going to go to the moon next week, but here is a summary of the results.

- 53% generally used the crossing once or more per day and a further 23% once or more per week. Thus the majority of red runners were familiar with the crossing
- 50% were filmed on their way to work and the majority over estimated the time they assumed the crossing was closed. They diced with death to try to beat the crossing
- 70% claimed not to understand the meaning of the amber warning light and 40% the flashing red light
- 55% of people pass through a flashing red light as opposed to steady red lights (25%). 16% of red runners passed 5 seconds or more after the red light appeared
- 25% of red runners claimed to be unaware of the crossing. Whether this was true or a belief that they did not expect it to close can only be imagined

Our prime policy to improve driver behaviour is through public campaigns to increase the awareness of the dangers of using crossings incorrectly, backed up with police endorsement to detect, prosecute and punish.

When I was the Zone Director LNE, I commissioned a short film as part of 'Operation Zebra', an extract of which I would like to show you now.

We have also bought a number of portable GATSO cameras which takes a photograph of a vehicle jumping the lights, or zigzagging around a barrier which can be used by the police to prosecute. This coupled with local publicity is effective in improving behaviour at particular crossing.

2. East / West Oriented Crossings

Particularly when associated with high average road speeds there can be a problem in seeing the crossing if the sun is low in the sky. In conjunction with the HSE we have experimented in using strobe quarts lights on the barriers, but generally this has not been very effective, because motorists are driving too fast and are not expecting (or willing to believe?) that the crossing could close. We are, in such cases, trying to seek the help of the HSE to persuade the Highway Authority to reduce the road speed by various means, such as putting markings on the road which get closer together as the crossing is approached to give the illusion to the motorist of the necessity to reduce his speed.

3. Changing the Crossing Type

We are converting a small number of AOCL crossings to ABCLs where there is a high traffic moment and there are other factors such as an entrance to a work place close to the crossing. Such conversions are expensive (£250K or more), so we can only afford to do it where the level crossing model would show that the reduction of risk was ALARP.

Conclusion

The safety record of level crossing in UK is extremely good in relation to other causes of road accidents, and also compared to those in Europe.

Generally automatic crossings have a higher utilisation than non-automatics and their associated risk levels are on average broadly acceptable. There are some however where reasonably practicable actions could be taken, and this is mainly through improving driver behaviour.

You have seen from the film what can happen if a level crossing is not used correctly, and this is true whether you are in England, Sweden or anywhere else. Make sure then that you never become a victim!

Railned

Organisatie voor Capaciteits management en Spoorwegveiligheid

LEVEL CROSSING SAFETY DEMANDS GOOD SOLUTIONS

Paper, prepared for the Fedecrail Annual Conference, Stockholm, May 1997

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1. THE ENVIRONMENT

One quiet morning last november, I was at my office reading some documents, when the operations manager of the heritage railway whose volunteer Secretary I am, called me to tell me that his civil engineers train just had reduced a brand new big Volvo to scrap. The two occupants were not hurt, but one of them escaped fatal injury by only a hair's-breadth. You can be certain that there are messages I like more!

In Holland, about 1200 people are killed in road traffic every year. About fifty of them are killed at level crossing accidents. This is one in every twenty-five victims, accounted for by a rail network whose most intensively used lines are free of level crossings. Imagine that in Germany and Great Britain, about the same number of persons each year is killed at level crossings in a rail network that is ten times as long, and it will be clear that in Holland, we think we have a safety problem. It has top priority, even over "real" rail safety, for the Department of Transport. It is still a mystery why these numbers are so high for Holland. A lack of driver discipline and the intensive nature of Dutch road traffic are just guesses for an explanation.

The main network of Netherlands Railways has about 3000 level crossings. About 1000 of them protected by automatic half barriers, about 800 are protected by automatic flashing lights and the others are unprotected. Many of these unprotected level crossings could and can be found on the secondary goods lines. These secondary goods lines never received the investment in modern level protection systems as the main lines. They also lacked the gated crossings that are so common in Great Britain. The man with the red flag, usually a shunter accompanying the train, was common, just as whistle signals and a few hand-operated red lights.

This is the situation the heritage railways inherited from Netherlands Railways, as they all run on such secondary goods lines. Mr Freden, from MRO, told me that Swedish heritage railways generally acquired their railways including modern level crossing protection, so, he asked, "Why all that fuzz about level crossings?".

A standard Dutch automatic half barrier level crossing costs at least DM 250.000 or £ 100.000. As a consequence, until now only one heritage railway could afford a second-hand one, that is installed in a line extension crossing an important regional through-road.

Another Dutch heritage railway was "blessed" by the building of new suburbs around its home town. This resulted in new four-lane access roads being built, with permitted speeds up to 80 km/h. They are protected by automatic half-barriers, that were paid for by local and regional authorities. Accidents and narrow escapes now are common occurences here. When you see the traffic levels and traffic situation there, it is clear that this level crossing should never have been built. An overbridge should have been build, but such an excellent solution for safety was too expensive for "just a heritage railway". An overbridge would be compulsary for a main line.

2. THE COSTS

In Holland, he who causes a change in level crossing lay-out, has to pay the cost - at least in theory. In Germany, the Level Crossing Act burdens a (heritage) railway with at least one third of the cost of any change, including building an overbridge for which the railway never asked for. This several times killed a (goods) railway. In Holland, I remember a case where the county council rebuilt a road, and then refused to pay DM 500 or £ 200 for some road markings. After a year of irritated correspondence, it ended with Netherlands Railways widening the level crossing for about DM 25.000 or £ 10.000, because cars hit the red lights about once a month! More often than not, the railway bears the brunt.

Railways are famous for developing safe and fail-safe systems. It has made the railway the safest mode of land transport. The widespread rail networks also necessitated standardisation of systems. The two automated systems for level crossings at Netherlands Railways, with and without half-barriers, are fully adequate for main line use. For secondary lines and goods branches they are a little bit over-engineered and expensive. As a result, many of these secondary goods lines lacked the protection required by modern road traffic.

In the 'eighties, the need for level crossing protection was again and again demonstrated by accidents, sometimes with fatal consequences. The idea to supplement existing traffic lights, fitted with a manually operated phase for trains, at an important cross-roads with a half-barrier because road traffic lights were not recognized as a legal means of level crossing protection in Holland, stirred your writer to suggest not to spend the DM 250.000 or £ 100.000, but to use the existing traffic lights, and to add just a few St. Andrew's crosses. To his astonishment, this idea was accepted! That traffic lights, instead of red flashing lights, were already compulsory by law in Germany and were also used in Austria and Switzerland, was an important circumstance for their acceptance in Holland.

It was the start of discussions with the Department of Transport to change the Railway Regulations so that two- and three-colour traffic lights would be permitted. This took several of years, but since 1 January 1995 traffic lights are legally accepted as level crossing protection when train speeds do not exceed 40 km/h. Already a year before the law was amended, an important secondary goods line was equipped with seven of these installations. Although more than 20 are in operation now, one version still has not been officially approved by the Infrastructure Manager that installed them .....

One heritage railway, at this moment still property of Netherlands Railways, also received such an installation, with a second being planned. For a more widespread application there is one small problem. The standard railway idea of building an installation as fail-safe as possible resulted in a price for a system with traffic light technology that is about only one half of the previous type of installation, which is equivalent to "too expensive to install a whole lot of them". Cables, necessary for a braking distance of 400 meters, are expensive. The Dutch obsession with reducing waiting times at level crossings made a fail-safe detection system necessary that added to costs significantly. The train driver must observe a signal that indicates that the installation works properly, and must (be able to) stop before the level crossing in case of a failure. For a heritage railway, a system like this is much too expensive.

Other costs should also be taken into consideration. In Holland, since a few years those responsible for public roads are responsible for damages caused by roads en road inventory, unless they prove their innocence. For my own railway, it was the reason to replace all St. Andrew's crosses with new reflective ones, conforming to the latest Department of Transport Standards. It would have cost us about DM 10.000 or £ 4000, when 3M, the well-known maker of reflective materials and a maker of road signs would not have sponsored us. Heritage railways should be prepared for investing to comply with higher standards than in the past, as they are part of a society that accepts no exceptions just because they are chronically short of funds.

3. THE PHILOSOPHY

Financial constraints within Netherlands Railways and with the heritage railways now again stimulated a quest for less expensive level crossing protection. As you know the Dutch railwaymen are very disciplined, and would never ever do anything against the rules or without the consent of their boss. So a location was found in a harbour area, where a really simple traffic light system, financed by the Harbour Authority, was installed at a spot where the Utrecht Head Office had no authority (but certainly with the unofficial backing of the specialists). The Harbour Authority of course thought a protection against very high tides unnecessary, so it has been drowned once in salt water (would you expect otherwise in a tidal harbour?), but otherwise it operates to everybody's full satisfaction. I now participate in a low-level discussion on a more widespread and formally approved use of such installations on goods branches and industrial spurs.

For goods branches, as for heritage railways, it would be good that level crossings are protected in a modern way. Standard railway equipment is fail-safe, but also is much too expensive. Standard components for traffic lights are not fail-safe by present standards, but they are highly reliable and much cheaper. We all trust them in daily road traffic, don't we? Accepting them for protecting level crossings is pure heresy for concervative members of the Institution of Railway Signalling Engineers. A good analysis of risks, costs and benefits should prevail over tradition. I think that a level crossing with traffic lights is something like 0,001 percent less safe than a (supposedly!) fail-safe system, but is some 100 times safer than an unprotected crossing. It is also much safer for the train crew that now stands in the middle of the road, and who sometimes have to jump for their lives.

The Dutch Railway Inspectorate fully supports the development of such less expensive and not fail-safe level crossing protection systems. Such a level crossing can, on approach, be monitored by the train driver. In fact, this is the only specific requirement of the Dutch Railway Inspectorate for installing non-fail-safe level crossings. The Railway Inspectorate also approves of adding half barriers, derived from barriers as used in parking lots.

I also believe that it is better to provide road traffic with signals they are familiar with, such as traffic lights. Many car drivers almost never see a railway level crossing, and even less see the red lights and half barriers in operation. The Railway Inspectorate states that road users must be able to recognize the specific nature of a level crossing. I do not agree with them at this subject. In my opinion, the job of level crossing protection systems is to stop road users, and it really does not matter if that is for a train, for a boat, for pedestrians or other for road traffic crossing his way: he just must stop! Ordinary modern traffic light systems can be a safe solution for many level crossings that need protection, but where the costs of a fail-safe installation are prohibitive. In Holland, every level crossing with a somewhat important road must be protected, and I was rather astonished to see such crossings in Germany being protected with only a whiste-blow.

4. THE CHALLENGE

A car driver does not mind that the train involved in a level crossing accident with his car was an ordinary train or a heritage train. Therefore, a heritage railway needs to prevent level crossing accidents and subsequent claims. The local public opinion also is a factor that should not be discounted.

Heritage railways are not looking for extra costs or for complex installations needing specialised maintenance engineers. They need something safe, simple, suitable and affordable. Standard two-colour traffic lights have proved to be a success in Holland, and, in their most efficient form, are within the financial reach of heritage railways. In their appearance, they are more recognisable for road traffic than the sometimes rather sparse red flashing lights.

Because many countries still only permit railway-style flashing red lights, it will be a challenge to have governments accept this change in road signals for level crossings. For those railways needing level crossing protection, it would combine safety with cost-efficiency. The challenge for the Fedecrail members will be to convince their respective governments and main line railways that road and rail safety is enhanced by a wider choice of signals and the acceptance of non-fail-safe but affordable level crossing systems.

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Tony Tomkins, Fourtees Consultancy, Environmental Management Services, Milton Keynes, UK.

PRAKTISCHE ASPEKTE FÜR DAS UMWELTMANAGEMENT BEI ERHALTENEN BAHNEN

Umwelt: Das was uns umliegt und wovon wir auch ein Teil sind.

Der doppelte Blickpunkt: 1) Wie wir die Umwelt wahrnehmen
2) Wie die Umwelt uns wahrnimmt

Wie Humphrey Bogart im Film "Casablanca" sagte: "Ich schau Dir in die Augen, Kleines!"

Was ist Wahrnehmung?: Die fünf Sinne

Geschmacksinn, Sehvermögen, Gehörsinn, Geruchsinn, Tastsinn

Wir bilden uns vielleicht ein, daß wir etwas anzubieten haben, und untermauern diesen Gedanken mit einer Philosophie. Wir müssen aber im Auge behalten, daß die Wahrnehmung immer durch einen oder mehrere der fünf Sinne vermittelt wird.

Im Zusammenhang mit unseren Sinnen und Wahrnehmungen sollte es einen überragenden Gedanken geben, der die erhaltenen Bahnen nur auf eigener Gefahr außer Acht lassen, nämlich:

"Ist es kostengünstig?"

Berücksichtigung der fünf Sinne:

Geschmack: Wenn Sie Essen und Getränke anbieten, machen Sie Ihr Bestes dabei? Könnte es noch besser sein? Oder erfüllen Sie nur die Mindestforderungen?!

Geruch: Das Wachrufen der Vergangenheit - heißes Dampföl und Dieselöl; der Geruch von Kraftstoffen und Rauchemissionen?

Angenehme Gerüche sind vorübergehend. Danach verschwindet die Angenehmheit des Geruches bis er fast ekelhaft wird.

Im Gegensatz dazu werden jene Gerüche, die von Anfang an schlecht sind, nie besser, sie werden nur schlimmer! Hier eine kurze Liste der ekelhaften Gerüche, die einem auf einem Bahnhof begegnen: Toiletten, muffige Wagen, Auspuffgasen und Dieselemissionen, Mülleimer, Schmierfett, schlecht verbrannter Kohlrauch, und schließlich um nicht diejenigen Mitarbeiter zu vergessen, die bei der persönlichen Pflege noch einiges zu lernen haben!

Tastsinn: Lassen Sie lieber die Finger weg! Ein guter Tip, da die Flächen oft schmutzig, naß oder schmierig sind.

Berührbare Flächen: Kleidungsstücke auf Sitzplätze; Hände auf Sitzplätze, Tische und Wageneinrichtungen.

Warum halten sich also nicht mehr Bahnen an der Redewendung: Sauberkeit ist alles?

Gehörsinn: Lärm kann entweder entzückend oder fürchterlich sein, normalerweise wenn er kaum hörbar .... oder schnell wieder vorbei ist. Zu viel Lärm kann gefährlich sein ..... wir erinnern uns an die Zauberkunst der Dopplers Wirkung.

Vorträge der 4. FEDECRAIL Konferenz, Stockholm, den 30. und 31. Mai 1997.
Tony Tomkins: "Praktische Aspekte für das Umweltmanagement bei erhaltenen Bahnen".
FEDECRAIL Vorstandsmitglieder/Kjell S. Palen

Anhaltendes und eindringliches Pfeifen - die eventuelle Belästigung der Nachbarn ..... Sagen Sie Ihren Nachbarn Bescheid!

Rauscharmer Lärm vibriert - es ist das spürbare Hören, wie z. B der Lärm einer stillstehenden aber noch laufend lassenden Diesel-Lokomotive.

Gilt in diesem Fall die Redewendung, die normalerweise für Kinder angewendet wird? und zwar, sie sollen gesehen und nicht gehört werden!

Sehvermögen: "Schön ist, was einem gefällt". Bilder aus der Kindheit oder der Jugend, die mit Freude wieder ins Gedächnis gerufen werden ..... das umgekehrte Verhältnis Gesetz betrifft auch hier: je weiter die Erfahrung in der Vergangenheit zurückliegt, desto lebhafter die Erinnerung.

Grau	v	Bunt
Schäbig	v	gut gepflegt
Schmutzig	v	Sauber

Wie nehmen unsere zahlenden Gäste die Atmosphäre der Bahn wahr? Sie vergnügen sich zu ihren eigenen Kosten .....

Und umgekehrt. Was sehen wir - die Bahnerhalter?

Ein Fall von Gesichtsfeldeinengung vielleicht? - der schmutzige Tunnel oder der grüne Tunnel?

Was können wir tun? Und wie können wir es tun?

Jean-Paul Balensi, French Delegation, FACS/UNECTO.

Comparison of the Regulation of Level Crossings for Museum and Tourist Railways in Various EU Countries.

1 THE PROBLEM.

In France, as in the majority of European Countries, the rules which apply to tourist railways concerning the crossing of roads at ground level are numerous and complex. They are often derived from the regulations of the national public rail network and lend themselves unsatisfactorily to the needs of museum and tourist railways, which constitute a very special category.

The aim of this presentation is to identify what are the main trends which seem to emerge from the evidence, what problems they cause for our operations, and what interventions will be necessary to promote a favourable evolution of the regulations.

2 THE METHOD OF INVESTIGATION

A questionnaire was devised to make the interpretation of the results easier. It was intended to be a complete list of the essential questions which the networks are facing. It was distributed to all the national federations affiliated to FEDECRAIL as well as to interested individuals from countries which do not as yet have a national structure. It received a good welcome, as indicated by the fact that a dozen or so replies were received.

3 THE RESULTS

3.1 The situation of rail networks vis à vis the Highway Code.

The following questions were intended to enable us to compile a list of the special features and problems encountered in relation to the signalling systems used for road traffic.

FEDECRAIL Conference Speeches. Stockholm, May 30-31, 1997:
Jean-Paul Balensi: "Comparison of the Regulation of Level Crossings for Museum and Tourist Railways in Various EU Countries."
FEDECRAIL Council Members/Kjell S Palén

3.1.1 The right of way of trains at level crossings.

In almost all the countries surveyed the Highway Code accords an absolute right of way to trains at level crossings. Please note, however, that there are certain cases where, despite an identical signalling system for the roads, a tourist railway does not have right of way over motor traffic.

3.1.2 The road signalling system

In two thirds of the countries, road signalling is the same for all types of level crossing. For the other third, many types of road signalling exist.

3.1.3 The red light (as used at road junctions)

In one third of the countries, the same signal is used at level crossings as at road junctions. For the other two thirds it is a different signal. In the latter case a flashing red light is normally used.

3.1.4 Conclusion

The regulations are fairly ill-assorted and there are several anomalies. The traditional red light is only seldom used.

3.2 The regulations applying to rail lines (in general)

The following questions were intended to clarify what are the main features of the regulations which affect rail transport in general.

3.2.1 The different categories of level crossing (for railways in general).

Three principal types were identified:

- Manned level crossings,
- Level crossings with an automatic signalling system involving lights and sounds but without barriers,
- Level crossings with an automatic signalling system involving lights, sounds and barriers.

Of course there do also exist unmanned level crossings. In one country they only exist at the moment on tourist lines.

3.2.2 The texts governing level crossings (for railways in general).

In almost all countries these texts take the form of laws, decrees and bylaws. More often than not many types of text apply simultaneously.

3.2.2 The organisations with decision-making power.

These include the Ministry of Transport, regional and local councils. Much depends on the relationship of the different authorities within the state.

Three interesting exceptions:

- In one country, the basic rules are decreed by the State, whereas specific regulations are prescribed directly by the railway operator.
- In another country, the railway operator makes the decisions itself on the equipment to be provided for level crossings in the case of lines which carry limited traffic.
- In yet another country, there is the possibility of discussion on a local level, which usually seems to prove problematic elsewhere.

3.2.4 Changes foreseen (for railways in general)

Few changes seem to be envisaged in this field, even if some are desired. In one country the traditional red light might in future be introduced systematically for all level crossings. In another country the phasing out of all level crossings is being advocated in preference to simply modifying the regulations!

3.2.5 Conclusion

Decisions are often taken at several levels. The large number of level crossings seems often to discourage the decision-makers to from attempting to change the present rules and equipment although some experiments are being carried out in this field.

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3.3 Special features applying to tourist railways in particular

These questions detail the specific situation of tourist lines.

3.3.1 Texts governing tourist lines

In the overwhelming majority, these are the same as those governing other rail lines, although some exceptions do exist in certain countries.

3.3.2 Texts relating to level crossings on tourist lines

It would appear that no such text exists in any country at the present time.

3.3.3 Right of way over road vehicles

This is the case in the vast majority of cases but the same exceptions are found as in section 3.1.1.

3.3.4 Compulsory halting of trains before level crossings

This is a rule which does not seem to be used by anyone. Prudence is necessary since it has not been made clear whether supervision by an official was required in addition.

3.3.5 Road signalling and tourist lines

For motorists the road signalling system is the same whether the level crossing belongs to a tourist line or another rail line (some dispensations seem to exist).

4 GENERAL CONCLUSION

The development of tourist and museum railways is recent and has tried to adapt to pre-existing texts. However these often do not suit the special situations of our operations. One does not run a train carrying 600 passengers at 40 km/h on the same basis as a cargo wagon carrying a load of sand to a commercial port! And yet the regulations are the same.

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In general problems are dealt with at the local level, but sometimes local councillors abuse the powers accorded them by decentralising legislation and make rules which are impossible to implement or which even increase the potential danger (as in the case where trains are obliged to stop before the level crossing).

In such cases the operators disclaim responsibility in advance for any accident which might result from an abuse of local power and an abdication of responsibility on the part of the legislators. Fortunately no tragedy has so far occurred - but there have already been incidents which have given rise to a tangled controversy. In order to prevent future deaths let us delay no longer.

We propose certain rules which would be clear and easy to implement:

1. The right of way of the train is absolute and permanent (except when the track runs along the road - urban tramways and port rail lines).

2. A single road signal across Europe will indicate both the manned and unmanned level crossings. It may be supplemented by a light signal at the discretion of the national authorities who will aim for a future standardisation of these light signals throughout the Community.

If this conference has been able to avert a tragedy such as is presently possible, your attention will not have been in vain. I thank you in the name of those potential victims whose lives will have been spared.

FEDECRAIL Conference Speeches. Stockholm, May 30-31, 1997:
Jean-Paul Balensi: "Comparison of the Regulation of Level Crossings for Museum and Tourist Railways in Various EU Countries."
FEDECRAIL Council Members/Kjell S Palén

The Swedish Railway Inspectorate

- Legislation
- Permits
- Approval
- Supervision
- Level crossings

JÄRNVÄGSINSPEKTIONEN

Banverket

The National Rail Administration

➥ ***Järnvägsinspektionen***

The Railway Inspectorate

➥ ***Tågtrafikledningen***

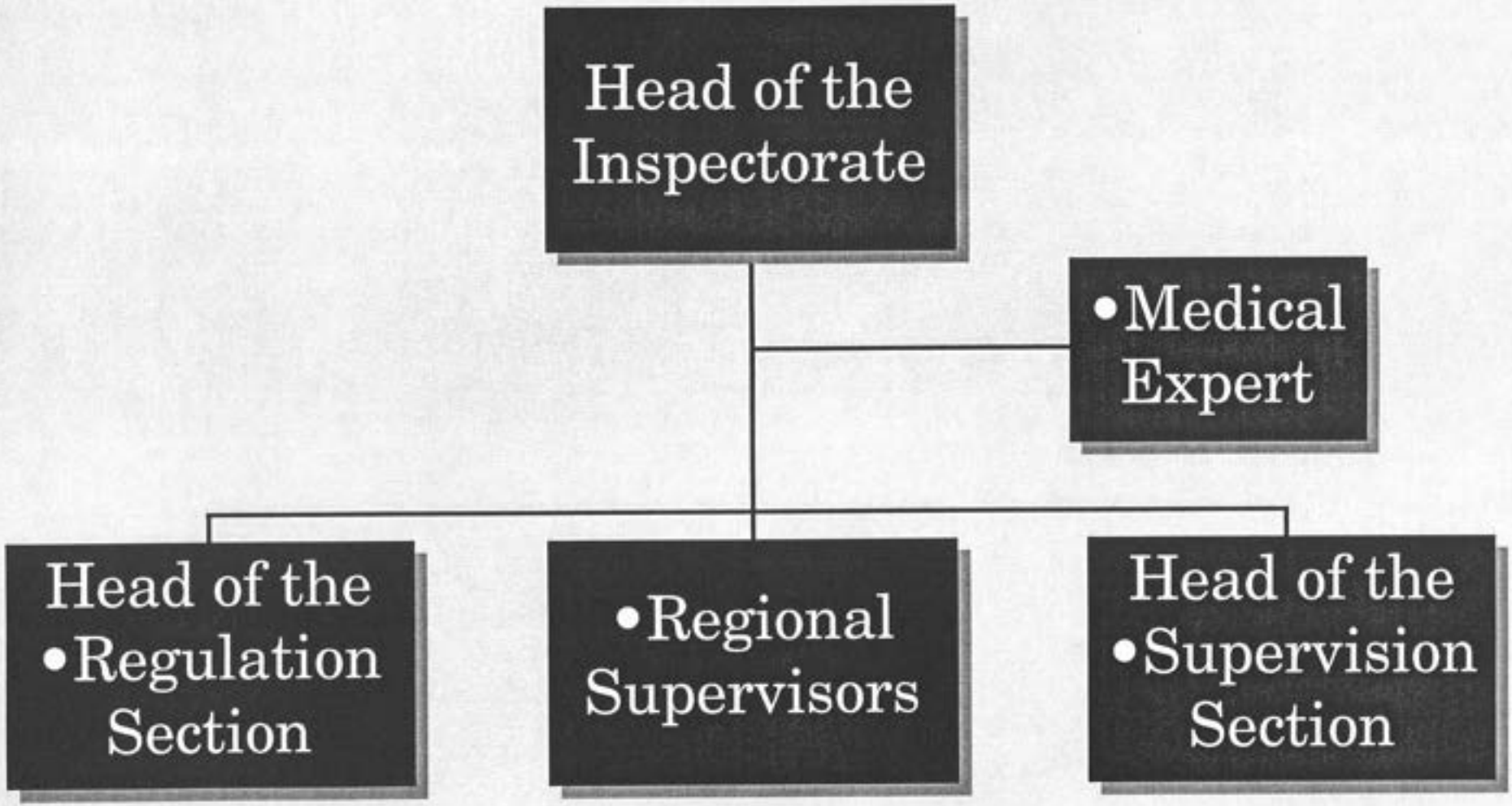
The Rail Traffic Administration

➥ ***Delegationen för kollektivtrafik***

The Committee for Purchase of Certain Public Transport Services

JÄRNVÄGSINSPEKTIONEN

The Swedish Railway Inspectorate



JÄRNVÄGSINSPEKTIONEN

TC 970527PM

Instruction for Banverket

Responsibilities and duties of the director of the Railway Inspectorate

9§ The director of the Railway Inspectorate is responsible for and decides in

1. matters concerning safety norms for railway, underground and tramway which depend on Banverket,
2. matters concerning supervision of the following established safety norms,
3. matters concerning investigation of accidents and other incidents in the traffic with railway, underground or tramway regarding safety to the extent that the investigation depends on Banverket,
4. matters concerning names of railway traffic interchange,
5. matters concerning permits, according to the Railway Safety Act (1990:1157), to operate railway systems, rail traffic or special traffic management operation; the revocation of such permits; approval of vehicles and installations; and the revocation of such approvals.

JÄRNVÄGSINSPEKTIONEN

The Railway Safety Act

Permit

➥ All operators except SJ and Banverket

Approval

➥ Infrastructure

➥ Vechicles

Supervision

Safety case

➥ Operators own procedures

JÄRNVÄGSINSPEKTIONEN

The Railway Safety Act

Operators

- Traffic operators
- Infrastructor operators
  - Special traffic management operation

The Railway Safety Act

Permit

- Professional knowledge
- Observance of law
- Financial
- Other significant factors

JÄRNVÄGSINSPEKTIONEN

The Railway Act

Basic provisions

➥ Operation, infrastructure, vehicles and other material so managed and at such a character that damage as a result of operations is avoid

➥ The necessary organisation must be arranged to ensure that the operation can be carried out in a safe manner

➥ Staff

– knowledge, skill, health and personal circumstances in general

➥ Safety case

– procedures that the operator needs for his management

➥ The manager is responsible

JÄRNVÄGSINSPEKTIONEN

The Railway Safety Act

Supervision

- Regular inspections
  - daily work by inspectors
- Theme inspections
  - one theme – several places – deep look
- Minor theme inspections
  - one theme – several places – summary look
- Management meeting
  - internal control
- System monotoring
  - deep look at one manager

JÄRNVÄGSINSPEKTIONEN

Level Crossing

Safety level of road protection decided by Banverket

- No new level crossings
  - a new may replace one or more older
- Gate light, bell
- Gate light
- Compulsory stop for road traffic
- Only road sign
- Nothing

...depends of traffic circumstances
(speed, number of movements and so on...)

JÄRNVÄGSINSPEKTIONEN

Thomas Engel/ /1948/ studierte Kunst, Archäologie und Ethnologie an der Universität Lund, Schweden.
Arbeitet seit 1990 bei der ***Länderverwaltung für Alvsborg. Hauptgebiet: Schutz des kulturellen Erbes***

Die Schwächen des schwedischen Kulturgesetzes

Das schwedische Schutzgesetz oder das Streben nach Vollkommenheit.

Dieser Vortrag ist aus schwedischer Sicht geschrieben worden, und beschreibt die heutige Lage und die aktuell gültige Gesetzgebung.

Ich bin Regionalbeamter beim Länderverwaltungsausschuß. Da ich die Verantwortung für die Anten-Gräfsnäs erhaltene Bahn im Gräfsnäs trage, habe ich eine gute Einsicht in die Probleme der Erhaltung und Darstellung stillgelegter und verfallener Industriewerke, Textilfabriken und veralteter Bahnen.

Sie ist eine der über 30 Bahnmuseen, die in Zukunft mit großen technischen und formellen Problemen konfrontiert sein werden.

Ich interessiere mich für die Probleme der industriellen Erhaltung nicht nur wegen dieser formellen Gründe, sondern auch weil ich im wahrsten Sinne des Wortes nur ein Laier bin - ein Liebhaber technischer Geräte, die sich auf- und abbewegen! Kolben, Zahnräder, Riemengetriebe usw. sind in unserer Zeit, in der das schnellste Computerchip angeblich alles lösen kann, faszinierende Gegenstände.

Ich setzte mich mit den Problemen auseinander, die nicht unbedingt denen Ihrer Heimatländer entsprechen. Ich gehe aber davon aus, daß Sie mit solchen Problemen vertraut sind. Sie beziehen sich im wesentlichen auf die Einstellung des schwedischen Kulturamts in bezug auf die Erhaltung und Entwicklung eines technischen Museums.

Ich glaube nicht, daß meine Lösung international angewendet werden kann, da eine Lösung immer die Konsequenz des ursprünglichen Problems ist.

Es ist möglich, daß bei der Erhaltung einer industriellen Anlage die Fabrik noch im Betrieb ist, der Inhaber sich aber für kooperativ erklärt. Diese Situation kommt aber sehr selten vor, und ich habe sie selber noch nie erlebt.

Ich bespreche hier auch nicht den Fall, in dem eine Anlage im Rahmen eines detaillierten Entwicklungsprojekts durch Bauverordnungen geschützt ist.

Die kulturelle Behörde ist eher eine Art Feuerwehrorganisation, die sich mit Brandkatastrophen befaßt.

Die beste Situation, und Sie stimmen wahrscheinlich hier mit mir überein, ist die folgende: es gibt eine erhaltene und funktionsfähige Anlage, die über technische Entwicklungen verschiedener Zeitaltern verfügt. Besucher können einen Rundgang durch die Anlage machen und von qualifiziertem Personal geleitet und aufgeklärt werden. Dies ist natürlich eine zu erträumende Situation.

Der Aufbau der schwedischen Antiquitätsbehörden

Um Ihnen meine Einschätzung des Problems der industriellen Erhaltung zu vermitteln, werde ich über die Struktur schwedischer Museen berichten, und zwar wie

ihre Tätigkeiten von der Regierung unterstützt werden. Anschließend werde ich einige Bemerkungen zu den Vor- und Nachteilen der Gesetzgebung machen.

Die Zentralen und Ländermuseen
An der Spitze der Hierarchie stehen die zentralen Stadtmuseen Stockholms, die vor langer Zeit die Museen von Schweden darstellten. Heutzutage trägt jedes die Verantwortung für ein Stück Geschichte, wie Technologie, Volkskunde, Ethnologie, Handel, Schiffahrt, Kunstgeschichte usw. Im Laufe dieses Jahrhunderts haben ihre Aufgaben geändert; anstatt die Ansammlungsarbeit bieten sie inzwischen Vermittlung und Unterstützung für die 24 Ländermuseen an. Seit der Jahrhundertwende sind sie gewachsen und sind verpflichtet, die kulturellen Einrichtungen zu beachten und zu fördern. Als unabhängige Organisationen sind sie weiterhin dafür verantwortlich, Material zum aktuellen Kulturleben zu sammeln, zu dokumentieren und auszustellen. Sie erklären dem Volk, wo gestern und heute sich treffen, und nehmen an öffentlicher Diskussionen über aktuelle Probleme aktiv Teil. Die Ländermuseen sind vernetzt.

Die Kommunalmuseen.
Ich schätze ein, daß ein Viertel aller 280 Kommunen über ihre eigenen Museums- oder Erhaltungsvertreter verfügen. Sie unterscheiden sich sehr nach Kenntnissen, Zielen und Ressourcen. Da sie mehr oder weniger direkt an die regionalen Politiker berichten, erleben sie oft Kommunikations-Schwierigkeiten.

Außer dieser drei Kategorien gibt es noch viele Museen, die von Individuen oder Privatorganisationen ins Leben gerufen und geleitet werden, und keine oder nur wenige Angestellten haben. Sie werden oft nach dem Modell einer Besucherstelle gegründet. Unter anderem gibt es Museen für Regionalgeschichte, Burgen und Schösser, Landwirtschaft, Sägewerke, Kornmühlen oder Hochöfen, sowie andere Industrieanlagen.

Der Länderverwaltungsausschuß, bei dem ich arbeite, ist ein regionales Amt, das im Auftrag der Regierung für nationale Aufgaben verantwortlich ist.

Ich bin politisch unabhängig und habe keine Verpflichtungen dem Ländermuseum gegenüber. Ich erfülle jedoch oft eine Vermittlungsfunktion im Bereich Staatsförderungen, Denkmalschutz und allgemeiner Schutzfragen. Als Beamte bin ich verpflichtet, das Gesetz zu respektieren, auch wenn es mich unglücklich macht.

Der Staat hat oft gesagt, daß die Erhaltung unseres gemeinsamen Kulturerbes eine wichtige Stelle einnimmt. In der Praxis zeigt der Staat sein Engagement durch die Vergebung von Förderungsmittel für kulturelle Zwecke. Theater, Museen und andere Institutionen erhalten finanzielle Unterstützung.

Der Staat hat unter anderem die folgenden nationalen Ziele festgelegt:
Die kulturellen Behörden werden das kulturelle Erbe erhalten und vermitteln. Dadurch wird der gesellschaftlichen Entwicklung historische Kontinuität verliehen.
Die kulturellen Behörden werden die regionale Identität fördern und die drohenden Gefahren für unser kulturelles Erbe bekämpfen.
Die kulturellen Behörden tragen auch die Verantwortung, das allgemeine Bewußtsein aesthetischer Werte und historischer Beziehungen zu fördern.

Man kann zwischen allgemeiner finanzieller Unterstützung und spezifischer Unterstützung unterscheiden. Welche Organisationen kommen für die allgemeinene Subventionen in Frage?

Es ist sehr einfach: abgesehen von einigen Ausnahmen werden die Mittel an etablierten Museen gegeben. Keinem privaten oder halbprivaten Unternehmen wird

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eine allgemeine Subvention gewährt. Die Zahl der Forderungen liegt weit höher als die zur Verfügung stehenden Subventionen.

Eine spezifische Subvention könnte zum Beispiel an Unternehmen vergeben werden, die allgemein bekannt und etabliert sind. Hier kommen zum Beispiel Museen für Gewerkschaftsgeschichte, Theatergeschichte oder erhaltene Bahnen in Frage. Angesichts des aktuellen Rückgangs der wirtschaftlichen Lage, sind Maßnahmen ergriffen worden, um die Arbeitslosenzahl zu verringern. Auf dieser Art und Weise haben viele unkonventionelle Unternehmen unerwartet davon profitiert.

Ein Hauptproblem besteht darin, wie man sich bei den Förderungsbehörden bekannt macht, ohne bei den etablierten Ländermuseen in Schwierigkeiten zu geraten.

Was wollen wir erhalten?

Der Industrialisierungsprozeß des neunzehnten Jahrhunderts hat Schweden relativ spät erreicht. Die industrielle Revolution begann in den 30er Jahren des neunzehnten Jahrhunderts. Als die interregionalen Bahnstrecken in den 60er Jahren fertiggestellt wurden, fing Schweden an, sich als Nation zu definieren. Regionale Sprach- Mode- und Zeit-Unterschiede verschwanden allmählich.
Die Zünfte lösten sich auf, der Freihandel, die Dampfmaschine und das metrische Maßsystem wurden alle eingeführt.
Die Gewerkschaften wuchsen und eine halbe Million junger Leute wanderten nach den USA aus. Diese Ereignisse geschahen innerhalb zwanzig bis dreißig Jahren! Was für spannende Zeiten!
Der Glaube an Technologie war unbeschränkt. Alle Probleme waren technisch zu lösen.
Die Symbiose zwischen Technologie und der strukturellen Entwicklung der Gesellschaft war unbekannt. Die gesellschaftliche Entwicklung und ihr Einfluß auf die Bürger waren genauso unbekannt.

Aber wie sammelt man Erinnerungen? Wie stellt man die Massen auf der Straße optisch dar? Oder die Gerüche, den Glauben an Technologie oder den unbeschränkten Optimismus? Es ist natürlich beinahe unmöglich, unfaßbare Ereignisse zu greifen und darzustellen. Ich befürchte jedoch, daß die allgemeine Bevölkerung und insbesondere die Museensbehörden des Verschwindens von elementaren Dingen unseres Umfelds nicht bewußt sind. Das Nationalmuseum für Technik hat kürzlich eine Umfrage erstellt, die sich mit 'fast erlöschten Produktionsprozessen' befasste. Eine sehr begehrte CD-Aufnahme ist vor kurzem erschienen, mit Tönen einer vergangenen Ära. Erinnern Sie sich an den Wagenrücklauf einer alten Schreibmaschine? Das Tick-Tack eines Weckers? Manuelle Taschenrechner und manuel getriebene Rasenmäher? Andere Töne haben sie ersetzt, mit denen wir uns abfinden müssen: dem Summen des Ventilators und dem elektronischen Pieps, wie auch dem intermittierenden Summen des Wechselstroms eines Hausgeräts.

Was können wir oder genauer gesagt was können wir nicht erhalten?

"Die Erhaltung" könnte verschiedenes bedeuten. Ich weigere mich hier, über die sehr seltene Situation zu berichten, in der jemand aus eigener Tasche ein Denkmal wohlwollend erhält und schützt.

Wie kann man durch die Anwendung des Gesetzes etwas verwirklichen?

Da ich beim Staat arbeite, darf ich mich nur im Rahmen des Denkmal- und Fundegesetzes 1988 aktiv beteiligen.

Es steht im ersten Paragraph im Klartext: "Die Pflege und Erhaltung unseres kulturellen Lebens sind von nationaler Verantwortung, die von allen gleichermaßen getragen wird. Sowohl Privatpersonen wie auch der öffentliche Dienst müssen das kulturelle Leben pflegen." Alte Denkmale und archäologische Funde werden in dem nächsten Paragraph behandelt. Das vierte Paragraph betrifft Kirchen und Begräbnisstätten; das Fünfte versucht, vor dem Export von Denkmalen nationaler Wichtigkeit zu schützen. Unter anderem sind das gemalte oder geschnitzte Möbel, Kunstwerke oder Bücher.

Das sechste Paragraph enthält Richtlinien, um illegal exportiertes Material oder gestohlene Kunststücke an den rechtmäßigen Besitzern zurückzugeben.

Zum Paragraph 3:
Paragraphen und Artikeln können allein den Schutz oder das ewige Leben nicht garantieren. Was kann das Gesetz tun?
Paragraph 3, Artikel 1 des Gesetzes lautet: Ein Gebäude kann nur historisch genannt werden, wenn es von historischem Wert oder Bestandteil einer Siedlung ist. Die Beschreibung "Gebäude" schließt auch Parkanlagen, Gärten oder sonstige Einrichtungen von historischem Wert ein.

Dieses Gesetz kann nur etwas schützen, was von Menschen gebaut worden ist. Das heißt, wenn ich ein Kanalgebiet schützen will, bin ich mit dem Problem konfrontiert, daß ich nur die Schleusen schützen darf. Hier ist das Gesetz klar: die zusammengestellten Teile, die Schleusen usw., können geschützt werden, nicht aber das freifließende Wasser, das für den Transport notwendig ist. Ohne das Wasser aber bleibt von dem Kanal so gut wie nichts übrig. Es ist aus meiner Sicht völlig unverständlich, wenn man das ganze Bild analysieren will.

Bei Wohnungen und ähnlichen Gebäuden geht das dritte Paragraph auf das schwedische Gewohnheitsrecht zurück. Ein Aspekt des Gewohnheitsrechts befaßt sich mit Immobilien und den Übertragungsregelungen für Eigentum zwischen Inhabern. Hier wird beschrieben, was unter einem Gebäude zu verstehen ist. Zum Beispiel: elektrische Leitungen, Wasser- und Abfluß-Systeme, Innenausstattung, Treppe, usw. Das Gesetz gilt, wenn das Gebäude bewohnt wird oder einem einzelnen Inhaber gehört.
Das Gesetz nutzt wenig, wenn die Wände eines Gebäudes einem Unternehmen gehören, die Geräte geleast sind und die Produktion in den Händern eines weiteren Inhabers liegt. Dieser Fehler verhindert eine wirksame Erhaltung einer industriellen Anlage durch Anwendung des Kulturgesetzes. Die Theorie klingt so gut: "die Pflege und Erhaltung unseres kulturellen Lebens sind von nationaler Verantwortung, die von allen gleichermaßen getragen wird."

Bemerken Sie: wir reden hier jedesmal von der Erhaltung *einer* Anlage oder *eines* Gebäudes. Die Probleme häufen sich, wenn wir versuchen, alle Gebäude innerhalb eines geplanten Schutzgebietes gleichzeitig unter Denkmalschutz zu setzen.

Der Schlußstrich ist wie folgt: wenn es uns nicht gelingt und wenn die Gebäude oder Einrichtungen nicht für bewohnbare Zwecke gebaut wurden, sind wir nur in der Lage, das Fundament, die Wände und die Dächer zu erhalten. Außerdem wird dies nur zugelassen, wenn die Gebäuden nicht anderswo nachgebaut oder umplaziert worden ist, was im 19. Jahrhundert in Schweden eine übliche Gewohnheit war, oder wenn sie nicht renoviert worden sind oder einen einmaligen Baustil haben.

Ein Bauernhof kann zum Beispiel unter Denkmalschutz stehen, solange er keine Leute und keinen Viehbestand hat und den Geruch von Heu und Dung nicht ausströmt! Die Äcker liegen normalerweise außerhalb des Denkmalschutzgebiets. Eine Weberei könnte später geschlossen und die Maschinen ausgeräumt werden. Der

Bahnhof einer stillgelegten Bahn wird erhalten, nicht aber deren Fahrzeuge, Personal oder Passagiere. Die Seitenschneider, die Drehbanken und die Bohrmaschinen einer Maschinenwerkstatt werden eventuell ausgeräumt.

War dies tatsächlich die wahre Deutung des Kulturgesetzes? War es das Ziel der Gesetzgeber, eine schmale Trennung zwischen der wesentlichen Funktion eines Gebäudes und dem Gebäude an sich zu ziehen?

Wie ich vorher erwähnte, wurde ich mit Problemen der Bahn schon konfrontiert, als Mitglieder der erhaltenen Bahn in Südwest-Schweden mich ansprachen. Ihr Problem war stets ein Mangel an Geld. Ohne Geld konnte sie keine freiwilligen Mitarbeiter engagieren. Als privates Unternehmen sind sie gezwungen, alle Finanzquellen anzuzapfen. Wie die Mehrheit aller Museumsbahnen in Schweden steht die Anten-Gräfsnäs Bahn auf eigenen Füßen. Sie wird nicht vom Staat subventioniert.

Da das Problem eher prinzipiell und strukturell ist, setzte ich mich mit dem Stadtmuseum in Verbindung, das für Industrie, Handel und Transport zuständig ist. Danach wendete ich mich an das Nordische Museum, an das Nationalkomitee für Altertümer, an das Museum für Technologie und an den Nationalverband für Kultur, um herauszufinden, wie die Kulturbehörden Fällen betrachteten, die den herkömmlichen Weg abgingen.
Sie waren alle einmütig der Ansicht, daß es höchst wichtig war, unser technisches Erbe zu erhalten. Zur gleichen Zeit war es aber klar, daß dies die Aufgabe der etablierten Museen war.
Die Gespräche endeten oft mit der Aussage, daß das Erhaltungsgesetz für den Schutz von Gebäuden und Einrichtungen ausreichte und die Aktivitäten uns als Beamten nicht angingen.
Ich hatte das Gefühl, daß ich in einen fremden Verantwortungsbereich eingegriffen hatte.

Bei dem Kulturverband in Stockholm gibt es Mittel, die für die Erhaltung alter Bahnen verwendet werden. In 1994 wurde in einer Untersuchung festgestellt, daß die gesellschaftliche Entwicklung und der Aufbau der Industrie und der Verkehrsmittel in einer ungewöhnlich engen Beziehung zueinander stehen. Es wurde auch darauf hingewiesen, daß trotz des Bestehens des Nordischen Museums es in Schweden kein Museum gibt, das sich mit Denkmalen des industriellen Zeitalters beschäftigt.

Da genugend Geld bei dem Verband vorhanden ist, könnte man hoffen, daß die Überlebenschancen gut sind. Aber nein.

Die oberste Nationalbehörde für Museen, an die ich auch berichte, ist das Nationalkomitee für Altertümer. Die Behörden dort waren für die Erstellung des Kulturgesetzes zuständig. Sie beabsichtigten, daß das Gesetz für den Schutz von Denkmalen und Anlagen bestimmt sein sollte.

Natürlich erzählen sie mir, daß man die Aktivitäten und Prozessen auf dieser Art und Weise nicht schutzen kann. Man muß mit der Erhaltung der Wände zufrieden sein und hoffen, daß das kulturelle Ziel des Museums auch ohne visuelle Effekte verstanden wird. Andererseits könnte man hoffen, daß jemand sich bereit erklärt, die Verantwortung zu übernehmen, die sonst meine wäre.

Dies ist völlig unbefriedigend. Warum fehlt die Vision? Warum sollte an der Basis eine solche einfache Sache so kompliziert und schwierig sein, wenn man mit Beamten umgeht?

Als ich erfuhr, daß ich diesen Vortrag halten sollte, wurde mir klar, daß mein Problem aus einer größeren Perspektive angesehen werden müsste. Betrachten Sie ein

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ähnliches Problem: Vintage-Autos und Schiffe. Laut der Regelung, dürfen sie auch keine Unterstützung bekommen. Das gleiche gilt für eine Vintage-Bahn.
Ein schwedischer Abgeordneter hat einen Gesetzentwurf vorgelegt, um das Erhaltungsgesetz zu aktualisieren. Kurz: er wollte Schiffe von historischem und kulturellem Interesse nach dem gleichen Verfahren wie für Häuser unter Denkmalschutz stellen. Der ständige Ausschuß für Kultur - ein staatliches Unternehmen - hat die folgende Antwort gegeben: Der Ausschuß hat bereits solche Gesetzentwürfe berücksichtigt ..... Infolge dieser Gespräche wird eine Subvention für dieneunzehn wertvollsten Schiffe angeboten. Der Ausschuß stimmt mit den Punkten dieses Gesetzentwurfs überein: Schiffe, Dampfschiffe, Klipper usw. sind ein wesentlicher Bestandteil des schwedischen Erbes. Nichtsdestoweniger hält der Staat den Besitzer für deren Erhaltung zuständig. Eine Änderung des Gesetzes könnte als Verletzung der Eigentumsrechte betrachtet werden. Der Gesetzentwurf wurde abgelehnt. Meine Meinung dazu: Jede sinnvolle Erhaltung bringt eine gewisse Verletzung der Eigentumsrechte mit sich.

Wie sieht es bei unseren Nachbarländern aus?

Es ist ziemlich offensichtlich, daß die nordischen Gesetzgeber die Kulturgesetze ihrer Nachbarländer mehr als oberflächlich gelesen haben. Einige Aspekte des Gesetzes sind fast wortwörtlich wiedergegeben worden.
In Finland erfährt man im Rahmen des Denkmalschutzes diegleichen Probleme, mit denen wir konfrontiert sind. Wenn ein Besitzer sich weigern sollte, sein Eigentum unter Schutz zu stellen, scheitert hier das Gesetz. Es ist weder in Finland noch in Dänemark möglich, die einzelnen Vermögenswerte eines Gebäudes, wie z.B. die Maschinen, zu schützen. Privatleute sind für ihre Erhalung verantwortlich, wie es auch hier in Schweden der Fall ist.

1975 gab das dänische Umweltsministerium zu, daß es Schwierigkeiten bezüglich der Erhaltung industrieller Anlagen gebe. Da der Denkmalschutz sich damals fast ausschließlich mit dem Schutz bewohnbarer Gebäude befaßte, prognostizierte das Minsterium künftige Defizite des Gesetzes im bezug auf die Erhaltung industrieller Werke, Mölkereien, Schulen, Krankenhäuser und Bahnhöfe.

Norwegen bildet die einzige Ausnahme unter den nordischen Ländern. Laut dem norwegischen Erhaltungsgesetz schließt die Denkmalschutzregelung sowohl das Gebäude als auch die Vermögenswerte ein. Die gesamte Anlage wird als Einheit betrachtet. Sehr gut!

Nur eine einzige Bahn in Schweden genießt das Privileg, unter Denkmalschutz zu stehen. Der Hintergrund dieser Entscheidung mag für Sie einhellend sein.

Die Schmalspurlinie, die die südliche Insel von Schweden mit der Ostküste verbindet, wurde etappenmäßig ab 1877 gebaut. Die einzelnen Strecken wurden später verbunden und die Gesamtstrecke wurde von der schwedischen Eisenbahngesellschaft, "Statens Järnvägar", verwaltet. Im Jahre 1984 hat die Gesellschaft die Linie stillgelegt. Seit einigen Jahren organisiert ein Privatunternehmen den Verkehr. In Zusammenarbeit mit der Nationalverband für Altertümer wurde vorgeschlagen, die Strecken, die den höchsten kulturellen Wert besaßen, unter Denkmalschutz zu stellen.
Nach heftiger Debatte unter den Fachleuten haben meine Kollegen im Länderverwaltungsausschuß den Vorschlag abgelehnt. Der Nationalverband für Altertümer erhob Einspruch. Die Länderverwaltung wurde gezwungen, den Fall nochmals zu untersuchen. Die Rettung der Verkebäck-Tolebo Strecke wurde empfohlen, weil sie die älteste Strecke der gesamten Linie bildete und von Menschen gebaut wurde.

Das Urteil des obersten Gerichts erhob die Frage, ob man nicht die Gesamtfunktion einer Anlage in Betracht ziehen sollte. Das Kulturgesetz habe nicht nur den Schutz von einzelnen Denkmalen und Stätten als Ziel. Daher gehe die Diskussion um den eventuellen Schutz einer Eisenbahn oder einer Lage von kulturellem Interesse. Das oberste Gericht hat das Gesetz interpretiert und kam zu dem Schluß, daß die Ziele der Gesetzgeber damals beschränkt waren. Das Ergebnis: Nur einem Marktplatz oder einer Straße anstoßende Häuser können als "eine Stätte von außerordentlichem kulturellem Interesse" verstanden werden.

Das Gesetz wurde durch die kulturelle Wirklichkeit angefochten und hat sich behauptet.
Aus der Sicht der Anwälter war die Absicht des Gesetzes belanglos.
Ungefähr 20% des nationalen Eisenbahnnetzes wurde mit Schmalspurschienen gebaut, wovon keine einzige Strecke noch im Betrieb ist. Man könnte sagen, daß sie völlig verschwunden sind!
Trotzdem wollen das Gericht und der Nationalverband für Altertümer nicht einsehen, daß eine Bahn an sich vom Interesse sein kann. Stattdessen verlangen sie technische Tatsachen, wie zum Beispiel die Baumethode einer Strecke, bevor sie einen Urteil geben können.

Was sollen wir tun?

Ein wachsendes Interesse an Geschichte ist heute allgemein festzustellen. Man interessiert sich für das Alltagsleben der Vergangenheit. Das Gesetz ist ihnen gleichgültig. Sie wünschen sich eine maßstabgerechte Darstellung samt Spezial-Effekten.

Die heutige Situation wird Auswirkungen auf die Erhaltung unseres industriellen Erbes sowie auf das öffentliche Interesse an Geschichte haben.

Wie ich schon erwähnt habe, gibt es außer den etablierten Museen viele kleinere, meistens private Museen, die von unermüdlichen Idealisten geleitet werden. Sie werden ausgerechnet von den Museen vernachlässigt, die sie unterstützen und inspirieren könnten. Der kreative Austausch von Sachkenntnissen wird dadurch verhindert.

Wie sieht es bei den Ländermuseen aus? Warum zeigen sie kein Interesse an Technologiegeschichte? Warum versuchen sie nicht, die Idealisten zu unterstützen? Technologie ja, Zusammenarbeit nein.

Es fehlt ihnen oft an wahren Kenntnissen über die große Bedeutung technischer Innovationen für die Entwicklung der Industrie und der modernen Technologie. Sie leben zum Teil noch im neunzehnten Jahrhundert. Sie sollten neue Fachleute, wie z.B. Geographen, Geologen, Wissenschaftshistoriker und Techniker, einstellen.

Meine bescheidene Empfehlung ist die folgende: alle Kleinmuseen und Besucherzentren sollten sich zusammentun und versuchen, mit den Touristenorganisationen der Kommunen zusammenzuarbeiten. Laßt uns ein kulturelles Netz aufbauen. In einer Familie begegnet man oft mehrere, manchmal sehr starke Wünsche, die alle befriedigt werden müssen.

Ich habe auf die Gesetzgebung hingewiesen, die auf den neuesten Stand gebracht werden sollte: es muß ermöglicht werden, nicht nur Wände, sondern auch Produktionswerkzeuge wirksam zu schützen. Die Maschinen, Strecken usw. sind für die Darstellung der ehemaligen Funktion einer Anlage unersetzlich. Einheitliche Schutzleistungen werden nicht von Ungefähr eingeleitet. Einzelne könnten sich zusammentun und Dachgesellschaften oder Trusts gründen, um sich effektiver

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Vorträge der 4. FEDECRAIL Konferenz, Stockholm, den 30. und 31. Mai 1997.
Thomas Engel: "Die Schwächen des schwedischen Kulturgesetzes".
FEDECRAIL Vorstandsmitglieder/Kjell S. Palen.

durchsetzen zu können. Dieser Vorschlag ist schon diskutiert worden und hätte einige Ähnlichkeiten mit dem britischen System.

Ich habe schon über den Mangel an Sachkenntnissen in den Hauptmuseen und den meisten nicht-technischen Museen gesprochen.
Ich habe die schwachen Beziehungen zwischen den etablierten Museen und den Idealisten erwähnt. Diese Situation führt zu wenig gegenseitigem Verständnis oder gemeinsamer Unterstützung. Der Grund dafür liegt natürlich an fehlender Kompetenz.

Ich wünsche mir ein organisiertes Netz, worin alle Kleinmuseen sich entweder auf eigenen Füßen stehen oder mit einer anderen Institution zusammenarbeiten.

Wir leben in einer Welt verschwindender Ressourcen. Niemand glaubt, daß wir durch eine Umkehrung dieser strukturellen Krise die Welt von gestern wiedererlangen könnten.

Ich stelle mir den Schlimmstfall vor, in dem die Ländermuseen noch vor sich hinarbeiten, vorindustrielle Artefakte sammeln, während wir bei der Länderverwaltung uns für die Erhaltung industrieller Denkmale eintreten, ohne Rücksicht auf das Gesamtbild zu nehmen. Dies wäre eine unvernünftige, unökonomische und mangelhafte Methode, wirksame Erhaltung zu ermöglichen.

Zum Schluß möchte ich Ihnen eine Liste aus einer 1996 von Annika Alzën geschriebene These vorlesen. Der Titel der These lautet:"Die Fabrik als kulturelles Erbe". Es geht um die industrielle Landschaft von Norrköping, einer Schwerindustriestadt.
In der Zusammenfassung identifiziert sie sehr genau die Unterschiede zwischen der heutigen Ist-Situation und der Soll-Situation von morgen:

Tradition bedeutet:	Die moderne Ansicht:
alleinstehend	Umwelt
Gegenstände	gesellschaftlicher Kontext
Heiligkeit	Verhandlung
elitäre Ansicht	Gemeinnutz
exklusiv	Trivialitäten
historische Ruinen	der historische Prozeß

Central Museum of the October Railway

Museum of Railway Equipment

Photo caption: the last steam passenger locomotive built in the USSR - class P36 No.0251. Built by Kolomna works in 1956.

Saint Petersburg, 1997

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photo caption: old-time train of suburban carriages built between 1900 and the 1930s. The train was formed in 1987 to mark the 150th anniversary of the first railway in Russia.

Russia's first Museum of Railway Equipment (MRE) was opened on 1 August 1991 and is a part of the Central Museum of the October Railway, which unites 28 'production museums' of railway enterprises in the North West of the Russian Federation. The museum bears the name of Vladimir Vasil'evich Chubarov, a former Chief of the October Railway, Distinguished Railwayman, Hero of Socialist Labour and first director of the Central Museum of the October Railway, who started the work on creating the MRE. The basis of the exhibition was formed by items of railway equipment which were collected by the October Railway in connection with the 150th anniversary of Russian railways. Apart from a constantly growing collection of rolling stock, it is planned to display track, signalling, central train control, automatic block and communications equipment, etc.

The museum currently has a collection of Russian- and foreign-built steam locomotives which were operated on the railways of Russia and the USSR. The collection's oldest exhibit is a 2-6-0T (1-3-0T, 1C tank), class TT No.1770, built by the German factory Jung in 1913. The oldest Russian-built steam locomotive is the class E 0-10-0 (0-5-0, E) No.950 built by Lugansk in 1915. Soviet steam locomotive design is represented by freight classes FD, E^{M}, SO, L, 9P and passenger classes S^{U} and P36.

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Steam locomotive P36 No.0251 occupies a special place in the collection. It is the last passenger steam locomotive built in the USSR, outshopped by the Kolomna works in 1956. It was acquired in Ussuriisk [near Vladivostok] in 1991, where it was being used as a stationary boiler, and an operation of unprecedented scale was undertaken by museum workers in 1992 to save this monument.

The collection also has foreign-built steam locomotives class Ea No.2201 (USA) and class TE No.6769 (Austria when part of Germany), both produced in 1944 and used on the country's railways in the post-war period. Amongst the museum's exhibits is class S^{U} No.253-15, which was one of the last steam locomotives working on the Novgorod-Leningrad route before dieselisation. The S^{U} class was the most widespread passenger locomotive.

Diesel locomotives in the museum's collection include freight TE1, TE2 and TE3, passenger classes TEP10 and TEP70, and shunting classes VME1, TG^{E} and TGM3. Rarities include the mainline diesel-hydraulic class TG102 No.153, built by the Leningrad diesel-locomotive-building factory in 1963, and also the experimental diesel class TE520 No.032, built by the Khar'kov diesel-locomotive-building factory in 1949 for operation in the Far North.

photo caption: electric locomotive class VL23 No.001. Locomotives of this class were the most widely used. They handled freight work on the October Railway from 1960 to 1994.

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photo caption: 4-axle armoured platform. Similar armoured wagons were widely used in the Great Patriotic War between 1941 and 1945.

More modest, as of the summer of 1996, is the collection of electric locomotives, comprising class VL23 No.001 and VL8 No.1522, both 3000V d.c. However, it is planned to add several more machines in the near future.

The MRE at Shushary has Russia's biggest collection of passenger carriages. Among them is carriage No.116, produced by the Russo-Baltic factory in Riga in 1878. It is the oldest surviving carriage built on the territory of the Russian empire.

The display has the main types of passenger carriage from the start of the century: 2- and 4-axle types with varying body designs, including the 'polonso' type with ??? lower half-walls in the body. Carriages of this type were used on the Chinese Eastern and Vladikavkaz railways and were distinguished by their high level of design.

The museum's collection of freight wagons includes various 2-axle types - the standard covered wagon, the tanker, the open wagon, the flat wagon - and gives a fairly comprehensive impression of the development of Russian and Soviet wagon design in the twentieth century.

Two recovery cranes, EDK25 and DZh45, acquired by the museum in 1996, enable vistors to acquaint thmselves with other types of railway equipment. Similar cranes were widely used for dealing with accidents and crashes, for loading freight wagons and replacing bridge sections.

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photo caption: Steam locomotive class S^{U} No.253-15, which hauled trains on the Leningrad-Novgorod route until 1976.

One aspect of the museum's work - cooperation with film studios - involves hiring out rolling stock for filming purposes. Thus, 24 museum carriages and wagons were used in the making of 'Anna Karenina' in 1996.

In connection with this it is planned to create a special stock of carriages and wagons so as not to disrupt the museum exhibition during filming and meet the film-makers' needs as well as possible.

A collection of 'live' steam locomotives has been made for use on tourist trains organised by foreign companies. These are classes P36 No.0027, LV No.0420 and TE No.2505, which were used on such well-known excursion trains as the Rus', the Polar Express and the Trans-Siberian Express in 1992-96.

Work on extending the museum's track space is due for completion in the very near future, and a building will be constructed for repairing and overhauling historic rolling stock.

The realisation of these plans will open the prospect of a more representative and varied exhibition, which will allow the museum to fulfil its main task in the best possible way - to preserve Russia's national heritage in the realm of railway transport.

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Map of routes to the Museum of Railway Equipment (travel by rail to the station 'Steam Locomotive Museum', using the first four carriages only)

Central Museum of the October Railway
191025 St Petersburg, Liteinyi prospekt, 62

For excursions: phone (St Petersburg) 272-4477

Compiled by Iu.L.Il'in and V.N.Voronin

Leonid Moskalev - Kustos des Zentralmuseums der Oktoberbahn, St. Petersburg, Rußland

Das Zentralmuseum der Oktoberbahn

Das Zentralmuseum der Oktoberbahn befindet sich in Liteinyi Prospect 62, St. Petersburg. Es ist das Hauptmuseum der Oktoberbahn, zu der ein Netz von 29 Regionalmuseen gehört.

Das Gesamtnetz schließt die folgenden Museen ein:

1. das Zentralmuseum - für die Koordination und Verwaltung des Gesamtnetzes zuständig.

2. die Regionalmuseen - befinden sich in Pskow, Murmansk und Petrozawodsk. - Die Oktoberbahn ist heutzutage in verschiedenen Regionalgebieten aufgeteilt.

3. die Lokomotivdepotsmuseen - befinden sich u.a. in Moskow (2) und St. Petersburg (3).

4. die Wagenwerkstattsmuseen - befinden sich u.a. in Moskow (1) und St. Petersburg (2).

5. das erste Lokomotivmuseum Rußlands. Das Museum befindet sich in Shushary, (umgenannt in "Parovoznyi Musei" Bahnmuseum), und verfügt über eine der größten Sammlungen von erhaltenen historischen Lokomotiven in ganz Rußland.

6. das Wagenmuseum - ist das einzige Museum dieser Art in Rußland. Das Museum selbst befindet sich in einem alten Wagen. Er fährt nicht nur auf der Oktoberbahnstrecke, sondern auf weiteren russisssschen Bahnstrecken.

7. Gedenkmuseen des Zweiten Weltkriegs (2)

Alle obengenannten Museen werden von dem Zentralmuseum der Oktoberbahn koordiniert, dessen Leiterin Frau Valentina I. Misailova heißt.

Das Museum verfügt über mehr als 46,000 Exponate, wovon ungefähr 16,000 im Zentralmuseum untergebracht werden. Die restlichen Exponate werden in den Regionalmuseen ausgestellt.

Die Sammlung schließt die folgenden Exponate ein:
- über 120 erhaltene Lokomotiven (in Shushary)
- eine Sammlung von Bahngegenständen mit den jeweiligen Fabrikzeichen
- eine Sammlung von Benzinlampen
- Unterlagen, Papiere usw.

Heutzutage gibt es 19 Bahnen in Rußland, (im Vergleich zu 32 in den ehemaligen UdSSR). Es ist aber entschieden worden, sie zu modifizieren.

Inzwischen gibt es insgesamt ungefähr 240 Bahnmuseen in Rußland. Sie werden hauptsächlich von dem Zentralmuseum für Bahntransport geleitet, das auch in St. Petersburg liegt. Es verfügt auch über seine eigene Lokomotivsammlung in Lebyazhe. Das Zentralmuseum für Bahntransport und unser Museumsnetz für die Oktoberbahn arbeiten parallel. Alle Bahnmuseen erleben zur Zeit Schwierigkeiten wegen der wirtschaftlichen Lage Rußlands.

Am 11. November 1997 feiern wir den 160. Jahrestag der Eröffnung der ersten Bahnstrecke in Rußland. (Die Strecke zwischen St. Petersburg und Tsarskoeselo wurde an dem gleichen Tag

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Vorträge der 4. FEDECRAIL Konferenz, Stockholm, den 30. und 31. Mai 1997.
Leonid Moskalev: "Das Zentralmuseum der Oktoberbahn".
FEDECRAIL Vorstandsmitglieder/Kjell S. Palen.

im Jahre 1837 eröffnet). Unser Museumsnetz ist zur Zeit mit der Vorbereitung der Feierlichkeiten beschäftigt und einige Ausstellungen sind schon geplant.

Die Hauptprobleme, mit denen wir zur Zeit konfrontiert sind, beziehen sich auf das Lokomotivmuseum in Shushary. Zwei neue Strecken wurden in diesem Jahre gebaut, wobei die Gesamtzahl der Strecken von 3 auf 5 gestiegen ist. Die Gesamtlänge der Strecken, die jeweils ungefähr 900m lang sind, hat sich damit verdoppelt. Die Sicherheitsprobleme sind inzwischen gelöst worden. Angesichts der aktuellen wirtschaftlichen Lage müssen wir die notwendigen Finanzmittel allein aufbringen, was uns durch die folgenden Unternehmen gelingt: den Verkauf von Besichtigungskarten; den Verkauf von Fotos, Kopien von Bahnzeichnungen und Andenken; und das Leihen unserer Lokomotive an Filmgesellschaften. Im Jahre 1996 bekamen wir ungefähr 500,000,000 Rubel (ungefähr 80,000$) von Filmgesellschaften, vor allem von dem Regisseur des Films "Anna Karenina". Diese Summe kann man mit dem gesamten Jahreseinkommen aller Angestellten unseres Museums vergleichen, das im Jahre 1966 435,000,000 Rubel betrug. Der Vergleich zeigt, daß wir damit sogar einen Gewinn gemacht haben.

Am 9. Mai 1997 liefert das Zentralmuseum der Oktoberbahn eine einmalige S.245 Lokomotive von Moskow nach Shushary. Diese außerordentliche Lieferung bildet unsere neueste Leistung. Das Museum verfügt inzwischen über 20 Exponate, die nach Shushary geliefert werden müssen.

Das Museum hat auch internationale Beziehungen, vor allem mit Finland, wie zum Beispiel mit dem Hauptmuseum der Stadt Luhti. Mehrere gemeinsame Ausstellungen fanden im Jahre 1995 in Finland und Rußland statt, um den Jahrestag der St. Petersburg-Riihimjaki Strecke zu feiern.

Das Museum arbeitet auch mit dem "Prince of Wales Trust", einer Stiftung des britischen Kronprinzes, zusammen. Dank dieser Beziehung durften unsere Mitarbeiter an Geschäftsseminaren teilnehmen. Wir lernen, mit dem neuen wirtschaftlichen System zurechtzukommen.

Das Museum freut sich auf den FEDECRAIL-Beitritt. Wir hoffen, daß unsere künftige Zusammenarbeit fruchtbar und interessant sein wird.

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FEDECRAIL 1997 CONFERENCE "S-97"
IN STOCKHOLM, SWEDEN
30 – 31 MAY 1997

Speaker: REINHARD SERCHINGER

Well, what I'm going to talk about today is steam locomotives and pollution, 1820's to 1990's. We all know that many of our museum and tourist railways are criticised for polluting the environment and because we use steam locomotives people complain about black smoke, people complain about the ash disposal and these problems are not new; in fact, at the very beginning when they started building railways there were already complaints. The first railways that used steam locomotives used coal, on the mine railways in Britain. And then when they started building railways for public transport then, of course, these railways also worked in residential areas and people complained about the black smoke and, therefore, from 1828 onwards, coke was used for steam locomotive firing. Coke basically only contains carbon and, therefore, burns without any smoke. Of course, if the combustion is not good you get a lot of carbon monoxide, which is highly poisonous, but you don't see it! OK, so then they used coke and this coke was used until around 1860 and in the late 1850's they started switching over to coal-firing again because coke cost about twice as much as coal and from an economic point of view it was nonsense to use coke because it was so expensive and besides the steel mills needed the coke. But then they had the problem of how to avoid the black smoke.

Now, what can we expect from exhaust gases from coal fired steam locomotives? I have written it down here. We have what we get in any combustion, we get carbon dioxide, which is not toxic but is supposed to cause the glass house effect, heat up the environment. When looking at this summer we don't believe it, it is so cold, but anyway it might have a dangerous effect on the climate. Then we have carbon monoxide which is oxidised in the atmosphere down to a carbon dioxide but as long as it is still carbon monoxide it is still highly poisonous for human beings and for animals, and you can't see it, you can't smell it. So, for example, if you have these carbon monoxide emissions within a locomotive shed when the locomotive is in

steam it might be dangerous. Well, compared with the carbon monoxide intake of the smoker when he has a cigarette it may not be that dangerous, but anyway we should avoid these things. Then we have hydrocarbons. Hydrocarbons are all the compounds and German coal * that may cause cancer, all these compounds made up from carbon and hydrogen. We have particulates, these are not a problem in steam locomotives because the particulates from steam locomotives are so big that you are not likely to inhale them, that is more a problem with diesel engines, * particles are surrounded by hydro carbon molecules and are very bad for your lungs. We have nitrogen oxides, which are formed in the combustion process from the oxygen in the air and the nitrogen in the air, and they are poisonous for trees. They cause the forests to die in combination with ultra-violet light and moisture and so, for example, if you go along the motorways the trees are healthy because there is so much dust that is whirling around because the cars are there, there is smoke in the air so the ultra-violet light does not get to the leaves of the trees; and then in other areas, where there is no industry at all, the wind transports the nitrogen oxides there and then the trees die. So this nitrogen oxide, these compounds, the formation of them crucially depends upon the temperature and the pressure under which the combustion takes place, that is the problem: the higher the temperature, the higher the efficiency of the more nitrogen oxides you get. Then we have sulphur dioxide, which is the sulphur in the coal or in the fuel burned, and the cause of the acid rain. And then we have two heavy metals, mercury and cadmium that have low melting points and are evaporated from the coal they are also highly toxic, so we should avoid them.

After this short introduction, what we can expect from those locomotives, we should ourselves know how to avoid it. And it was, as I said before, the transition from coal firing that took place in the last century and it was crucial to avoid the black smoke. How did they do it? First of all they had to find out which type of coal was suitable for use in steam locomotives and then how to avoid the smoke. It was general knowledge already, in the 1860's, how to avoid black smoke in principle – you have to supply sufficient draught to the fire so the steam locomotive uses the exhaust steam to produce the draught. But then they introduced the blower to have draught when the throttle was closed, the regulator was closed, they also introduced the brick arch. The brick arch is a very important thing. I'll come to that.

But first, we'll have a look at the coal because that is also important. If you have a good locomotive and use the wrong coal it won't help you. I have here the specification for environmentally friendly coal. For the German speaking delegates I have it in German, and in French, so if anybody is interested they may pick it up here in German and French. The most important thing is the amount of volatile constituents, and the volatile constituents of the coal. That is, the gases in the coal should range between 19% and 28% of the * and ash-free substance. If you have more gases in the coal than that you are stuck with a problem because then you will have smoke emissions. You can avoid them by somehow altering the firebox arrangement; but you have to do it otherwise you don't get smoke-free combustion in a classical steam locomotive. If you have less then you are more on the coke side and coke, besides being expensive, has another disadvantage, it burns away your grate; it also burns away the firebox walls where it is in contact with them. That was another reason why they wanted to get rid of the coke. But, as I said, smoke emission was very important and the fines in the early days of railroading were much higher than today. In the 1820's and 1830's, in Britain, the fine for emitting smoke from a steam locomotive was one tenth of the price of a new locomotive, just for one instance. So, these volatile constituents are crucial for not having black smoke. The lump size should be the size of a fist or a bit smaller, depending on the size of your firebox and the slits in the grate that you have. There should not be too much water in it but that is not really that crucial because if the coal contains more water and you keep it in a dry place it will get drier. There should not be too much ash and the air should have a high melting point, I mean there have been steam locomotives in regular operation with ash content up to 20% but it is not really what we should aim at. The sulphur should be below 1%, again to avoid the sulphur dioxide emissions and to avoid excessive corrosion of our tubes (and the firebox walls in copper fireboxes). For those who remember my talk in Strasbourg two years ago, there the specifications were even tighter. I have added some more specifications but the general specifications are not as strict any more. I had a look at all the coals available and with a strict specification you are limited to very, very few coals. This may not be practical and a more detailed look into the methods showed that this is a very good compromise between the availability of the coal, the price, and the environmental effect. The lower calorific value of the crude coal should exceed 28 *megagels* and I can repeat it again, I think it a fair compromise, we learn English but the English

adopt the metric system, so it's all metric! Of course, there should be as little as possible slack in the coal.

Then there are further parameters. I introduced this talk saying "steam locomotives and pollution 1820's to 1990's", so if you try to do all the experiments today it is enormously expensive; so what I did was historical study of old test reports and stuff, what can we learn from it? You know, as they say at Siemens in Germany, efficiency is the laziness of the intelligent. You know, when looking it up in the literature, not doing it again, is the way of intelligently and cheaply doing it; and besides there is another German saying, stupid paper makes the old mistakes all over again, intelligent paper makes new mistakes. We should in pollution reduction avoid the old mistakes and we can learn about them from the literature. That's what I did here. I said before, we need a high melting point of the ash because otherwise the ash will melt and flow into the grate and block it because the cold air is coming below and then we are stuck with the problem. So iron in the coal greatly reduces the melting point of the ashes, 5.5 grams of iron per kilogram of coal is the maximum otherwise you are stuck with a problem. Because these two compounds are formed in the case of lack of air and they reduce the melting point, so that is what we don't want. And then I talked about these heavy metals, mercury and cadmium and there are also limit values here to protect both the environment and the people working with the steam locomotives, there is a limit value for the cadmium concentration in the air at work places and if you take that, divide it by two and assume guys fixing like the turbo generator next to the chimney of the locomotive might inhale the gases then this is it, with a safety margin of 2.

Now, using the right coal is one aspect of avoiding pollution and the coal for example that could be used here is the Silesian coal, which is a bit too gassy and the Ruhr coal, those are the ones that I looked into. I talked a bit about the brick arch, you know, and I will talk about the Ruhr coal later on because we did some research on the ashes and the firebox ashes and the smoke box cinders, they were analysed and this research was sponsored by MRO in Sweden and Swiss Locomotive and Machine Works and then VDMT took over the lion's share of the costs, thanks to Heino, and he said to me yesterday I should speak in German because they paid the lion's share of it, but I said "the lion's share of those present speak English so...!".

Well, I talked about the brick arch to avoid black smoke. Now, how long should the brick arch be? You see this is an old Prussian locomotive first built in 1906, the P8, it has a very short brick arch. There was some testing by Mr Stroke, who started systematic locomotive testing in Germany and he made some experiments and concluded that the brick arch was only good for protecting the lower tubes from getting blocked but had no other use. This idea was erroneous but that's why they always used the short brick arches in Germany, just to protect the tubes. They never realised fully that the brick arch has to guide the gases and lengthen the flame path in order to burn volatile constituents. We talked about the volatile constituents, the gases that are emitted from the coal. First of all they must be ignited, so it must be hot enough and they need time to burn because they are gases, they are drawn through the tubes and then out of the chimney and it takes some time to burn them; and they must be in contact with air. So if you have a long brick arch then it means that the brick arch is heated up in the fire, a) it ignites the gases and, b) whirls them around, mixes them with the air and lengthens the flame path and they never realised that. Unfortunately old customs die hard, if you look at a German design, the standard boiler of the 1950's, you still have the short brick arch, now with the combustion chamber, which is not a very efficient arrangement either, many people believe in the combustion chamber but it would be much more sensible to have a larger grate and a long brick arch which would have the same effect but you avoid the losses of fine coal getting out of the chimney because for the given amount of coal that you have to burn if it is a small area then all the air to burn that coal must go through that area and the air velocities will be higher, so it is much more likely that the small coal particles get entrained in the draught and get out of the chimney unburned. If you have a big grate and a long brick arch then you have a long flame path and you have the low air velocities through the fire bed. This is what the East Germans did and they did it in a much cleverer way than the West Germans. You see, the old customs die hard. How long should the brick arch be? I did a rough estimate as to how long it should be and arrived at the conclusion it should be two-thirds of the inner length of the firebox. Then I met Mr Porter and he had done a more detailed calculation and he had arrived at 65%, which is a fairly good agreement with two thirds and I only had made a rough estimate and he had done the detailed calculation so that saved me a lot of work, to do it properly! And then, I did, for this talk, I did the historical study and found that the

American test empirically arrived at the same figure, they just tried it out for the stokers because on the stokers you have the problem that the coal is ground, otherwise it can't be conveyed by the worm-drive and so they found it out empirically that it should be two-thirds. So it is all in perfect agreement if you have a long firebox. Of course, in a small firebox it is no problem to make it sufficiently long but in a long firebox you can't support the brick arch and that's why the Americans introduced those water tubes so you have some additional heat transfer to the water and they at the same time carry these bricks, and so you see it is from the Alvin Mechanical Stoker and *Prospractice* which is in a book by Adolf Giesl and there you see how the flame path is, how it should be. This also applies to small locomotives and so it is highly recommended on small narrow gauge locomotives to have a brick arch. How should that be designed? This is a rough draft, here on top we have the old arrangement between the wars with a big slope of the grate and you, of course, have to fire the back corners like an armchair and it will roll in front and burn there and you should have a brick arch and in more modern engines you have a flatter grate without a slope and then you have to fire a bit more evenly. If you have smoke problems then there is a) the brick arch and b) and this is an English invention, to use an air deflector, a little air deflector on top of the fire hole inside the firebox. You see how the secondary air coming in is guided and that even further extends the flame path. If you have the *Marcotti* fire door that we use in Germany, if you open it, it opens in a way that it provides just the direction for the secondary air intake while you fire. So once these things are obeyed you should not have any problems, for example, if you use the Silesian coal, which is now Poland, and you have the test stage for the coal in the German literature because before World War II it was part of Germany, then this coal is very gassy, it has the advantage over the Ruhr coal that it contains very little sulphur but it contains about 30% to 33% of volatile constituents, that's a little bit too high; but if you have these long brick arches and use a bit of secondary air, not too much (and we'll come to that later), the secondary air intake through the fire box door can help to burn off the gases but it cannot help if the general design and the drafting system is not sufficient, and there are experiments from Austria that I will show you. Here you see Mr Porter's gas producer combustion system I talked about two years ago and Mr Porter will do it himself next year so I don't want to repeat this but they have secondary air fire holes which introduce the whirl to return the coal particles to the fire bed; then you have to

modify the locomotive completely. I am talking here about using the basic design and optimising it.

If there are any questions you are welcome to ask.

Now we are talking about draught and the chimney produces draught. What should a chimney look like? These are the different types of chimneys. You see this type here was used in Austria and this is the optimum type of the classical chimney and if you introduce there instead of the standard blast pipe of one * nozzle then you greatly increase the efficiency. So this is the guide line, you see the American ones came close to it in a way as far as the distance between the blast side and the chimney is concerned, but the form of the chimney was just a straight tube or a slightly outwardly sloped tube and you have to make it in a way like an injector, or an ejector, this is the right shape. In Germany they always used a big distance between the blast side and the chimney in a way that does not spoil the original external appearance of the engine but greatly increases the efficiency of the blast furnace, just inside the smoke box extend the chimney downwards, like this here. Then use the * nozzle and you have already an efficient draughting system. The only problem is if you use * nozzle down here then you have a highly efficient draughting system, a highly efficient front end, but you spoil the sound of the engine. You can see it on the new steam locomotives built by SLM At full load they have a good sound but at lower power ratings they sound like a diesel engine on a little fishing boat and it just isn't the right sound.

Well, another solution, we have two more solutions, and this is the diesel ejector, of course, invented by the Austrian, Diesel, and here you see this is the whole amount of work used in the front end and this is the useful work. Here the Diesel ejector fares best. The problem is, and the other thing is the * exhaust. * Porter, which has this optimum like shape of the chimney and four * nozzles down there, so the De La Valle nozzles are only useful to you over critical pressure and so there is much controversy as to what to use, the Diesel or the *. Really the Diesel ejector is the better chimney but why did the * come close to it? Because, in fact you have an over critical pressure in the blast pipe at the moment when the piston valves open and the steam is let out and Mr Diesel was well aware of the virtues of the De La Valle nozzle and he

used De La Valle nozzles for the blower because they are more efficient and said you don't need it for the chimney because the pressure, the back pressures are low enough so I don't have over critical pressure and I have the possibility to adjust the chimney. The fact is that highly time resolved measurements could show that you have an over critical pressure at some point, the optimum chimney would be a Diesel ejector with seven De La Valle nozzles. That would be the optimum. It hasn't been built so far and I suggested it to SLM but they wouldn't build it because they said that tourists like the round chimneys better on the engines. So maybe we can try it out some day.

Now, once we have straightened out the chimney problems then we come to the next crucial point, how to fire. How should we fire the engine? In this respect there are some tests in Austria. By the way, one must say that the Austrians did a great lot of very good research work and it was this early German testing and research that I talked about arrived at the wrong conclusions and the Austrians, they did the right experiments, they did not do too many experiments but they just did a few but they very cleverly arrived at the right conclusions very quickly and then when the Germans started heavy testing in between the wars, in the '20's, they made a lot of experiments but sometimes they didn't draw the right conclusions from them; but on the other hand this is valuable material today to conclude from.

Well, so, this is a test carried out in 1911 and early 1912, published in 1912. They used two engines, the 440, or in Gemany, the *, that's a two cylinder saturated steam, express engine on level track; and 2AO, that is not * 280, 2 cylinder compound saturated steam freight locomotive on a mountain line. In one case coal from Austria was used and in the other one Silesian coal was used. Now what can we conclude from this?

Question from the floor: *Silesian coal is from Poland today.* I said that before, and in the German literature it is called the Silesian coal because that was at the time part of Germany. The Polish locomotive coal that you get today, from * and this is the gaseous coal, it is a very good coal, as I said, it contains very little sulphur but you have to extend the brick arch and do something to avoid the black smoke.

Ok, well at the time it was not Polish coal it was Silesian coal, and if you look it up in the literature, if you read the test report, also if you read test reports in English where they compare it to the German things, they say the Silesian coal but its what you get from * today. Polish coal.

Ok, now they found out very quickly something that is very obvious, the air excess number, so you call it *, for example, as * 1.5 it means 50% air excess or if it is 1.31 it is 31% more air than you need theoretically. So, of course if you draw more air through the fire bed the coal has a better chance to come into contact with the air and so the combustion process itself will be better and you get less poisonous monoxide. This is obvious. But on the other hand, if you draw too much air through the fire bed you heat up a lot of air rather than the boiler, you know, and the water, that's what we want. So, because the heat transfer will be better if the temperature gradient is higher, the difference in temperature is higher, so with the same heat that you have if you heat a lot of air it has a low temperature, when you want to have a high temperature. So it is obvious that in order to have good combustion you should have more air. In order to have the high efficiency you should have less air, but on the other hand, if you have carbon monoxide, or too much carbon monoxide you also lose because it is not fully oxidised down to carbon dioxide and you lose that chemical energy. So there must be an optimum of the boiler efficiency somewhere in between and the Austrians found that the optimum was at *1.3, so 30% more air than you need theoretically was the optimum there. That shows that this design of the 440 engine was rather good because later standard engines of the Deutsche *Bahn, they needed an air excess of about 1.5, so that means that the general construction of the grade and so forth was much better in Austria. But why was that so? Well, I showed you those short brick arches in Germany and the Austrians, even in those days, used brick arches that covered 50% of the firebox length not two thirds, but at least 50%. So you see the influence of that. Then, we can also conclude other things from these experiments. Now, if you are in that 1.3 range there, 30% excess, you have relatively decent boiler efficiency and you have low values of carbon monoxide. If you introduce more air then your boiler efficiency goes a little bit down but your carbon monoxide goes down very rapidly and in those days they did not do these tests in order to minimise the pollution but in order to minimise the costs, and so the coal consumption and then these two load points are better than this one here, but you see you get very little

carbon monoxide. Another factor that is important in firing is, first you have to fire the engine right. Well, there are some ladies present here but I think they can take a good joke. You know, steam locomotives are like women, you have got to fire them right and then, boy, they give you satisfaction, and you see it here. (This was not politically correct but ok!). You not only have to build up the fire in the proper way but you also have to shovel in the coal a little bit many times, only a little bit at a time and then again, and not a lot at one time, and then wait and then fire a lot again. The Austrians measured the average amount of coal fired at one time at a time and you see here if you have 23 or 22 kilograms at a time or 24.6 even there, where you have more air excess, then you have these low values of carbon monoxide. But if you fire more at a time, a) your average * goes down and these are average values over long runs, that's what you have to do because in an oil fired locomotive you have stationary state, you can measure the fuel flow, but on a steam locomotive you don't have a stationary state, you fire and the coal emits the gases, it starts burning, it burns well and you fire again and so it is kind of a wavy thing, you know. So you have to stick very close to the optimum * to have the optimum efficiency all the time and the minimum pollution and that's why you must adjust it to a normal stationary state, fire a little bit and let the fire burn and fire a little bit again, and fire a little bit again, and fire a little bit again; and here you see it, I mean, one serving 22 kilograms or 24.6 if you have more air in proportion to 30 which is not that much more but there your CO goes up and also your efficiency goes down. And they did very long tests over regular runs and so this is very instructive. The other engine tested was with coal from Austria, from what is today, Bohemia, the Czech Republic, and this other coal was what is today Poland, Silesian coal, and this was the 280, 2 cylinder compound engine. It was found that in the 2 cylinder compound engine you never get enough draught because in a 2 cylinder engine at one revolution of the wheels you get 4 puffs but on a 2 compound, 2 cylinder compound engine you get only 2 puffs and that's not enough and this engine never reached the optimum, they never got enough air through the fire bed. So that is why we don't have any 2 cylinder compound engines any more, they disappeared. They have 4 cylinder compound engines and 3 cylinder compound but not 2 cylinder compound engines any more. We see that only with a very low fire bed we get a decent CO value and a decent * but it never reached the optimum. Now if we have a usual fire bed and we use the * system, that is the secondary air supply through the firebox door, going into the corners, supplying

secondary air to burn the gases in combination with that brick arch then in a regular fire bed even despite the My* system this value is without the My* system, then even with the My* system we get a bad value, you know, and the boiler efficiency goes down, the boiler efficiency here is higher than there because the grade was bigger and so the gas velocities in general were lower but you could have obtained a higher boiler efficiency here. So that is what we learned from it. You can use secondary air to burn off excess gases and to improve the combustion process of the volatile constituents if the gas is emitted from the coal. But secondary air does not help you if the general draughting system is a mess, then it doesn't work. And here you see, this was a medium high fire bed and this was a high fire bed, at the end of the trip and you see you have the My* system again but, well, it doesn't get down and the efficiency goes down. If you have a high fire bed and you fire a lot, again you see the influence here, 29, 25, 27 relatively large grade. That's ok, but if you fire 43 at a time then you your * goes down even further and your carbon monoxide goes up to 3%, you know. So that is what we can learn from these old tests. Fire only a little at a time.

Well then, testing in Germany continued, well this was Austrian testing and I said before that the Austrians were much better at drawing the right conclusions from the experiments. The Germans did an enormous amount of experiments but not always drew the right conclusions from it. And here you see smoke gas analysis as a function of the steam produced per square metre of heating surface an hour and you see how widely it varies. So if the authorities tell us, please let me know what your steam locomotives emit, just like cars, I mean, each car, each type of car, each engine, is tested separately for emissions and quite apparently steam locomotives are different. You see here, 64 or 19, and we'll come back to this engine later on, the 64 class is a 262 2 cylinder super heated steam passenger locomotive so Deutsche.*, everyone knows what a 64 is in Germany, so this 64 class as far as environmental things are concerned was the best engine of the old German ReichsBahn. You see, that's very low .* and efficiency do not contradict each other but they go hand in hand, if you pollute the environment then your efficiency is also very low, and vice vesa. So I stuck to this engine also in the ash and cinder research; as Peter Oglestone said to me, "Oh, well, of course, we only considered the purest of the pure and give these results to the authorities". Ok, so this engine is very good as far as CO emissions are

concerned and others are very bad, you see this varies from 0.1%, at full boiler load the engine had 0.12% CO and other engines had 1%, so there is a wide variation. And if we try to carry out tests according to today's standards, I mean on a coal fired steam locomotive, then you have, if you want to have something comparable to the ISOF rail traction cycle for diesel engines, for diesel locomotives, and quite a few years ago (it was published in 1993) I developed the test cycle for steam locomotives comparable to the ISOF rail traction test cycle and beside the one test point that idling or stand still in the shed, which is easy to measure, you have two low points in the case of the diesel engine. Since the characteristics of a steam locomotive are different to achieve you have to measure three test points on a steam engine and in those days I contacted the German railways, they have a test bench for locomotives in Munchen*, and I asked them how much it would cost to rent this to measure steam locomotives. It was 6,000 Deutschmarks a day and so to set up all the apparatus and if you get it right you have to find the load points and everything, so if you are very, very good it takes you at least two weeks, and then add to this the cost of hiring the measuring apparatus and add it all up it would cost about 200 or 250,000 Deutschmarks to do it on one steam engine. And this would be valid only for one type of locomotive. Then, of course, you have to use a very good fireman; you have another fireman who is not so qualified then you get worse results. It is not reproducible, this hand firing is not reproducible because it crucially depends upon the skill of the fireman. So we can draw conclusions from this but the main conclusion is if you maintain the engine well and if the brick arch has the right length for the coal you use and if your smoke box is tight, and this is another problem. on many museum railways unfortunately not enough consideration is given to smoke box tightness, I'll come to that in a minute, then the one most important thing is that you fire the engine right. And so fireman training is of crucial importance.

Question from the floor: [Isn't that a picture of the* the general German boiler was long.* We can discuss the German standard boiler afterwards, it had quite a few deficiencies but we will do that after the talk, ok?

I don't want to embarrass you but I know that the 24 and the 64 are the same boiler. That's right, but this has to do with the coal used. You see. The 24 class worked in East Prussia, it was called the Prairie Horse there, going over the prairies of eastern

Prussia and they used the gaseous Silesian coal which they were not made for and with the short brick arch. The 64 worked in the West on suburban passengers and they used the Ruhr district coal, so this remark was good because there is one thing we can see here, it is the same boiler, the same engine but German engines were designed for Ruhr coal and not for the Silesian coal and so there you see it.

Well, these are just some more pictures that give you an idea how vastly different these types of locomotives are.

Smoke box tightness is a problem you know because in the smoke box you have the two steam tubes going to the cylinders and there you have the exhaust steam tubes coming back to the blast pipe and these holes in the smoke box they are not really well tightened up in many cases on museum and tourist railways and it is very, very important to tighten them up and it is very simple. You go to any store which has general car spares and you buy * gum gum and you really heavily daub it in there and it is air tight and it is ok. I did it on my engine and it worked perfectly. So a very simple measure with a big effect and you don't have to do fancy things like a * searing on the fire box door which is super but you don't have to do it, just see to it that everything is tight, the way it was designed.

We talked about these different kinds of emissions. In these old tests they measured carbon dioxide and carbon monoxide as I said not because of pollution problems but carbon monoxide means a low efficiency of the combustion process. So we have this carbon monoxide data, but we don't have any data on the hydrocarbon emissions and no data on the nitrogen oxide emissions. Now, if you have the temperature of the fire bed then if you measure that you can theoretically calculate the nitrogen oxide emissions, you must know *, the air excess and you must know the temperatures of the fire bed and you have the gas analysis then you know how much nitrogen is in there and how much oxygen is in there and then you can calculate it. But as far as hydrocarbon emissions are concerned, there is nothing. There is absolutely nothing. When we did the testing on the new Swiss steam locomotives, the R*, built by SLM, first delivered in 1992, then we did not measure the hydrocarbons either because you need flame ionisation detectors and you need two of them and to rent them for one month, to lease them for one month, costs 20,000 Deutschmarks each and SLM was

not willing to pay for that. It was a pity and we couldn't measure, it wasn't measured in the past, it remains to be done and the only thing I have found in the literature was when they analysed the gases for the total hydrogen content, so contained hydrogen as hydrogen and in these compounds and it is not a test on a train. They did boiler tests, they removed the piston valves and fired the boiler and then the steam went through these steam chests into the chimney and that's the way they tested boilers. I have found if you compare the data so obtained and the data obtained in regular service then all this stationary boiler testing is a lot of shit. And I tell you why, because in regular operation you have all these parts, chugga, chugga, chugga and in this stationary testing you have a constant flow through the blast pipe and so then, of course, the combustion is much more even and much better. Then you do stationary boiler testing and you say "Oh, I have a wonderful boiler!" and then you put it into practice out on the road and it proves it just doesn't work. That is another experience, SLM did stationary boiler testing and they were lucky, the boiler didn't work out when they stationary tested it so they had some hints already before they put it on the engine; but if it works there it does not mean necessarily that it works on the engine. But what they did there is measure the total amount of hydrogen coming out, and as usual it is always the dry gas, so it is not water vapour that is taken out of there, because you always dry the gases before you measure the content. This is over a wide range of loads, it is fairly even. So we might conclude it is safe to say if you have very low values of carbon monoxide then your combustion is good and if you don't have black smoke then you also have very low values of hydrocarbon, that is safe to say. Then you see it is very even over a wide load range. Well, that is all we can say, we never measured it.

You have here, curves for various engines, the total coal consumption as a function of the cut off. In order to have low overall emissions we should also save coal. And in order to save coal we have to operate the engine in a way that is economical and so old engines you will find have their optimum cut-offs between 28% and 35% and, of course, if you go lower than that then the steam flow into the cylinders is obstructed because then the piston valves open only very small holes and there you have pressure losses and that is why the efficiency goes down. If you use higher cut-offs then you don't use the expansion of the steam. So we can learn from this that there are some engines that need cut-offs of 50% here or even more than that which shows from a thermo

dynamical point of view and from the cylinder design point of view they are very bad engines. But usually they range between 28%, 35% or 40% and, of course, if you have cut-offs lower than 35% and your bearings are not too good then you might bugger up the bearings even further – it happened to me while I was trained in Turkey as a steam locomotive driver and I slipped the cut-off when we had it very low loaded at 25% going up the mountain, thinking I was going very fuel-efficiently and when we arrived at Uzek the bearings were buggered, and I said, "Well, but the minimum cut-off here, on the 52 class, is recommended 25%" and they said "Yes, in Germany with your bearings, but we have Turkish bearings and here it is 35%!" And they said "Well, now you see you buggered it up and you will fix it, you want to learn it anyway!" I spent a day fixing the big end on the 52 class, you never forget these things. If your engine is in poor shape forget all about the fancy low cut-offs but use the 35% cut-off; and on older engines it's the most economical one anyway. Or in South Africa, when the ~~garage~~ Garratts in their last days were so clapped out, they said "No, we don't use a fancy 25% cut-off because there is so much play one engine unit will be going forward and the other one will be going backwards."

(Roger Stenuson)

From the floor: *I think the reason for the high cut-off was 4 cylinder compound, you need to run them at high pressure so as not strangle the low pressure.* Yeah, but I am talking about simple expansion engines here. mostly we have on tourist lines. No, the one that had the high cut-off was the T20 class, and it was the T20 class that was 2 cylinder.

(interchange from the floor)

Here you have some ideas as to the fuel efficiencies you can expect, that means drawbar ~~by~~ horse power versus coal consumption and this is indicated horse power versus coal consumption. That gives you an idea of what these values were, if you are interested we can photocopy that later on.

Now, if we try to conclude from this what we can expect from locomotives, then I have done a little bit of calculating last night before we started drinking beer. The steam locos fared very poorly and were 800 times worse than today's trucks but this morning after we had had some good Augustina's dark stout beer last night then I

found the mistake, which proves that beer is a good brain booster and you know we can say 8% or you can ride at 0.08. And this is effective 100% and I found that one, and then it's only 8 times worse, I calculated the carbon monoxide emissions. Now, the problem is if you calculate it, since these old guys didn't do it for environmental reasons, there is always one value missing. So, if they measured the fire bed temperature then you don't have the coal analysis; if you have the coal analysis you don't have the fire bed temperature. Always one little bit is missing. So in very few cases were these .* stuff here. The test was done with Westphalian coal and then I didn't have the coal analysis, I had the other data. But then in the Heuschel handbook I found the average coal analysis of the Ruhr coal used at the time and so we could calculate it and if you calculate it for the 64 class, make a rough estimate of course, then the carbon monoxide emissions are 17.2 grams per kilowatt hour of indicated horse power. And the Euro 3 emission standard is 2 grams per kilowatt hour for the trucks. So that is 8 times more but if you have, for example, such a diesel engine in a diesel locomotive you lose 8% for the auxilliaries on the diesel engine and another 20% on the power transmission, whereas on the steam locomotive your whole losses add up to only a maximum of 6%. If you take that into account, that is emissions versus the power delivered at the rim of the wheel, then the steam locomotive fares a little bit better. But anyway one must say that this is the best engine, the 64 class and others have values 5 or 6 times higher than that. And I wanted to do the nitrogen oxide as well but I didn't have the temperature of the fire bed so this might be found somewhere else in the literature, one might measure it on a museum locomotive.

Well, this was the first part of the talk on the emissions and now there is the second part of the talk, how much time have I got left? ***(about minus 25 minutes)*** Oh! Sorry, I hope I didn't bore you too much. Well, we did this coal research and the question was in America many localities now treat smoke box cinders and firebox ashes as toxic waste and when I was a child in Germany then they used steam locomotive ashes as gravel, for making gravel roads, for making parking lots, and our school yard was paved with steam locomotive ashes. And so I thought, well, this must be rubbish, they did it in those days and the drinking water was OK and I went to Austria and on the iron ore mountain railway there, in the old days the farmers there came and got the smoke box cinders and used it as a fertiliser. Well, I talked about that two years ago in Strasbourg and thank goodness we found these sponsors and so I went first to

Bruckhausen Wilhelm and picked up some ash and cinders there but unfortunately they fired up the engine with old scrapwood, you know, with old paint containing lead and cadmium and all these nice things, so I decided it may not be the right thing to analyse. Then I went to *railway Brienz Rothorn and they use very clean firewood. They use the firewood that you use in your fireplace at home for heating up the engines and they use the Ruhr coal and so we had very reproducible conditions there and we did test runs with one of the engines, engine No 7 built in the early 1930's by SLM. We did test runs over a whole day, firing up the engine with this wood and then firing the engine with coal. It was done by the regular fireman and at the end of the day I took the specimens from the smoke box, the cinders, and the ashes from the firebox and the people at *railway Brienz Rothorn, they mix it and give it away to a construction company that lay cables in the ground and they fill up these ditches with these coal ashes; because they say then the mice don't come, or the other animals don't come and bite into these cables. OK, so is that safe? And I can say yes, the first thing we did is test the coal and as a result we saw these coal specifications, (some of these papers have already been taken), so the one result is the coal specifications in combination with the literature and the other thing is that we tested them, may they be used as road construction material and do they endanger the drinking water? And the answer is, no! This coal ash, we used the Ruhr coal from the G* General Grubbental mine in the Ruhr district, this coal is used by BRB, by many of the VDMT member railways. It was found that if you use this coal then it is absolutely safe to use the ashes and cinders as road construction material and they fulfil the stiffest regulations for recycled construction material that exists in Germany. The second thing is, we tested it for drinking water protection and it also fulfils all specifications for drinking water protection except that the aluminum content is too high. Aluminum is in there and the content is too high, the * of these ashes (analysis (?)) contain too much aluminum (which is not that dangerous) but the aluminum is very good because it increases the melting point of the ashes, so it is a desirable part of the coal. If you have trace aluminum in the coal it is good for your combustion process. But that is the only complaint and the PH value was a bit too high for the smoke box cinders. That is not a problem because the smoke box cinders should be pressed into bricks and used for firing up the engine because basically that is coke, the smoke box cinders are coke and they don't contain these volatile constituents and in order to avoid smoke in shunting in India in the old days (and you find it in the English literature), they used smoke box cinders from the main line

engines to mix them with 50% cinders/50% coal for the shunting engines to avoid black smoke on the shunting yard, so we should find a way to press these cinders into some bricks and use them and that would be a way of reducing our smoke emissions in the running sheds.

Well, if you give me another five minutes I will talk about smoke prevention in the running shed or if you don't, if you want to have lunch, then I will stop. ***Carry on.***

Ok, we have talked a lot about how to avoid smoke emissions out on the line when running the trains, how can we avoid the smoke emissions when heating up the engines? Because there we have the shed and the neighbours of the locomotive sheds they complain a lot because if they live near the line and the train passes by the smoke is gone but if you live next to the loco sheds you have the smoke problem every weekend. So this is a bit of a problem and there were several ways to solve it. The way the Swiss Locomotive and Machine works solved it, they thought they had invented an external electric heater so these new steam locomotives built by SLM, you have an external electric heater which you connect to the boiler of the engine and it will heat up the water from the water side so very evenly and they give a 60 years' warranty on their boilers if you use that device, because you do it without inducing any thermal strains and stresses you heat up the boiler, you can even 'phone this device and it will be switched on automatically and your engine will be ready. Now Roger Hallen of SLM was very proud of this invention and then in 1993 when I firs came to this country and visited ~~was at S* and , S*~~ Gävle where he took me to the library and we had a loc at the old Swedish *, a text book on steam locomotives and it was in there. It is call in Swedish (I hope I pronounce it correctly) "*" (an elektrisk ångpanna for electric boiler for ste locomotive reserves). That's what they did here, they had the cheap hydro electr and they used exactly that! And you find it from 1947. I photocopied it and s copy to Roger Hallen and said "Well, you just re-invented it", he was not too pleas

Ok this is one option in a country where you have cheap electricity and it i good option because it extends useful boiler life, then you still have to hea engine but the problem when heating up the engine is it is just too cold so th emitted from the coal won't ignite and if you have a hot fire box already likely to work out much better. Another way to do it is to heat up coal a in Germany in the 1920's, in Frankfurt – they used big stoves and

with compressed air and put the coal in there, kept it burning all the time and took well burning coal and put it into the locomotives, and this worked very well and these stoves were very popular with the workers in the running sheds, especially in winter. They would gather round the warm stove and have a good time there and it was found out that they usually took 6 kilograms of coal to the steam locomotive to heat it up but it was very expensive to keep that stove burning all the time and then it was increased to 30 kilograms which worked much better; take 30 kilograms of coal to the steam locomotive engine, surround it with fresh coal and once all that coal burns you would distribute it over the grate and that worked very well in combination with the ring blower put in the chimney but they found it too expensive to keep that stove burning all the time. Then they made other experiments, they put in fresh coal into the fire box and designed a blower with the cartridge from old oily substances, waste, you put the cartridge in, then you light it and then there was compressed air blowing into it. This worked to some extent but the people at the running sheds boycotted this measure, they said it wouldn't work or they deliberately buggered up the device in order to keep these stoves because if you have this burner it doesn't warm you in the winter, you can't gather round a nice hot stove where you can cook your meal and have a good time and you just have this burner out in the cold. So they said well, this doesn't work and under the direct supervision of the inventor in Frankfurt it worked out but in other places they said "No, it doesn't work" and they left it too long in the fire and it would be burned and they said it was just not practical. Then in 1930 Mr *Sholtki a German physicist, invented this device for stationary central heating systems with coke and it is called in German, the Flammuolf in English you might say the Flame Wolf. This is a hair blower fan and inside is porcelain containing platinum wires and heat up the air, you get a red hot tip here. So we tried this out last year in ~~Murray Freight~~ Mariefred and it worked in principle but it did not overcome the problem: We also had black smoke because we put in coal and then we tried to light the coal and the coal got hot, the gases were emitted but the environment, the surroundings of the coal, were not hot enough, so we had the black smoke. You can light the locomotive with it but you cannot avoid the black smoke. This is a problem and I talked to Hans Wicklund and 'phoned him before I came here and he said they use it for their stove for the blacksmith and there it works very well but they don't use it on the engine. The next thing we should try out here is to put some coke, all these bricks made from the smoke box cinders, if we use the smoke box cinders which are coke, they come in

very small grain and they will fall through the grate so we have to press them together or use coke, ignite it with this device. I got the last 100 of them, they were made in the '30's and in 1939 Hitler stopped their sale because they said they needed the electricity for the war effort. Well, nonsense, but anyway, after the war in Germany they introduced central heating with oil and so the inventor's grandson gave me the last 100 of these and, of course, they are pretty much rotten. This is a re-built one according to present safety standards and everything and I had it done by an electrician and he charges me 250 to 300 Deutschmarks for restoration of one of them, that depends upon the condition, but then everything is new: all the wiring is new, there are new roller bearings here and that fan so then it is in really top shape and if you want to fix it up yourself, if anybody wants any of these, I can give them to you for the price I have to pay for the restoration, or, if you want to have the scrap ones, I have 6 of them with me; and you want to re-build them yourself, Sven did one already, then you can have them for free, of course. Because I got them for free. This should be a way to try it out with coke and then use coal.

You are clapping hands, you want to have lunch, ok, I stop now, thank you for your kind attention.

Any questions to the presentation?

Roer Stenerson: ***What I wanted to ask was, taking that slogan from Colorado, the best strawberries were always along the railway lines with the stiffest climbs. So, the emissions from a steam locomotive, are they any good at all?***

What it is, and this is not only a saying in Colorado, in fact the wine farmers in Germany along the Rhine valley, along the Moselle valley, complained about electrification and so what we can guess, I do not think that the smoke from the steam locomotives is good for the plants, it doesn't do them any harm either, but what is good is the smoke box cinders because they contain valuable minerals for the plants, so you say along the steep climbs, in America that is where you have the self-cleaning front end, so all the cinders come out of the chimney and they are distributed along the railway line on both sides along the steep climb so that's the fertiliser. Also this research sponsored by FEDECRAIL member railways which clearly showed that these smoke box cinders actually, and also the ashes, contain valuable minerals for plants and you can use them as a

fertisliser but it depends upon the plants and if you suggest they are good for strawberries and good for wine, but I am not a biologist but I know a biologist and I want to give the results to her so that she can tell me for which plants it would be useful.

We have been talking about only coal fired steam engines, what about wood fired engines?

Yes, wood firing, I did not have a look into this but wood firing is much less of a problem. I did not look into that and I have never been on a wood fired engine. ***In Finland a big part of all the museum engines are wood fired.*** And do you have smoke emissions from these locos? ***Not very much.*** Not very much, so I have to visit you in Finland and fire them to learn something new. ***You are welcome.***

Can the speakers please tell his name and organisation? My name is Guido Rossi ***from*** Piedmontese ***Museum. Can you tell us anything about coal from Venezuela?*** No. I have no idea whatsoever. ***I can! Don't try it!*** (Lars Stenersen)

Tony Tompkins, Leighton Buzzard Railway, UK.: Have you any comments regarding ashes which when laid on the railway seem to prevent plant growth? No. You see, actually these ashes are fertilisers. You will have more weeds. ***Ok, the other observation for those interested in timber burning, on one of our*** Orenstein ***locomotives, we burn sleepers, but we agreed with the local environmental office not to do it, there is nothing wrong with the timber but the creosote in which they had been treated was very black.*** Yeah, yeah, you have dioxides in there so you should not do that, really. It makes sense not to do it.

About burning sleepers, we had to burn sleepers for a long time and it will destroy the smoke box. Just don't use the microphone it is much more difficult to understand.

Next is Mr Morgan:
Moving away from the man ***technical aspects of your talk, Reinhard, you carried out quite an extensive amount of research already into steam powered locomotives, what area do you think would benefit us for further research in forthcoming years, bearing in mind environmental pressures, the need to refute popular prejudices, such as the one you have indicated with the fertilising aspects of coal cinders, what area do you***

think we should be looking at? Well, I think as far as looking into the past and as far as theoretical things are concerned, this is quite complete. One could do some more research calculated for various locomotives and extend that a little bit further but then the most important thing that we should do now is what we have learned from these past experiences, put it into practice at various railways and see how it works out in practice. Because what you find in the literature is only the theoretical knowledge, even if it concerns practical things, but the tacit knowledge that you only get from hands on experience we have to re-acquire that by practice on our museum railways. And so besides what I have presented here I looked into the Ruhr coal and I looked into this Polish coal from the former Silesian district and some of the railways use them. But the questions that arose here, that, for example, in England they use other coal and stuff like that so we should do more coal analysis of other coal used by a number of member railways; we might look into these wood fired engines about which I don't know anything, so it's a good idea to come to Finland next year and do it there; and so we could go along those lines. But as far as theoretical research is concerned I think that it has come to a satisfactory conclusion; we now know what we have to do, we have to put it into practice. We might try to use these smoke box cinders as firing bricks for heating up the engine, trying out these things, but that is experimental and practical work at the running shed is what I would suggest.

Dennis Dunstone from the UK: I worked for 30 years for an oil company and one of the things which puzzles me is why burning oil in steam engines hasn't become more popular. Would you like to comment on that? Yes, I didn't talk about this now because I talked about it 2 years ago in Strasbourg but the new engines built by SLM are oil fired and in fact from a technical point of view oil is the best locomotive fuel because oil has the highest calorific value in comparison to weight so in that respect it is better than coal. You can handle it much more easily, you don't have to fire it and so there are two ways of doing it, using oil firing. The first thing is to convert the locomotive to oil firing with extra light heating oil or No 2 heating oil as they call it in the US, that is the light heating oil you use in domestic heating, that is what the new Swiss * engines run on and you get enormously good emission values with that fuel, which are much better than modern diesels. Let me have a look, I don't know how familiar you are with these new engines, I just have to find the slide, I can show you. * They heated it up with the electric boiler, this is the new engine when we

tested it, it's a bit dark, it was switched off, that was the problem, I didn't know * I have it. This is the new engine when we tested it, of course we built a test run for it, it was 1992 when we did that and here you see the emissions of this new locomotive with No 2, extra light heating oil, and a diesel of the same vintage. You see that the steam locomotive fares much better in overall pollution and that presently 52 Class engine, 5280, 55? is converted to that oil firing at SLM, so it's a very good option, but it's an expensive option and if you have oil fired engines of the old type then the Union Pacific standards are applicable. Union Pacific worked out specifications for oil fired locomotives, they call it their No 5 fuel and it is basically a mixture of heavy fuel oil blended with 10/15% of diesel fuel oil, light No 2 heating oil and it works out very well. If you are interested in that I can give you the specifications. .... ***waste oil?*** Yes, one should not burn waste oil, they did that in Turkey and I might have told you, I was trained as a driver and fireman in Turkey, and we had that stuff there It is very cheap but, there are several problems with the waste oil: If you use waste crank case oil then this takes a lot of trash and then the burner will not burn evenly, it will kind of splutter and will go out and then re-ignite and then you might have explosions in the firebox and during the latter days of steam in the US, when they still had oil fired steam locomotives but many diesels already they did that, and they had many casualties and many fatal accidents because of explosions in the fire box using that waste oil. So in that respect it is dangerous. The Turks did not do that this way; they properly filtered and separated the waste oil. They first filtered it to get all the trash out and then they separated it so they allowed the water to settle and then the water was drained from below. So this waste oil did not contain any water any more and no trash any more. And then there was a big mixer inside, so that there was an even distribution and these diesel fuels and stuff, it was evenly distributed. But then still the flash point of that oil is too high for successful firing really, if you do it you should mix it with a little bit of diesel fuel or No 2 heating oil. But then still there is one other problem, these oils contain a lot of acids and this was found in Turkey during the last years of steam operation. These acids in the waste oil, they ate away the super heater elements, you wouldn't believe it.

Peter Thomas
(***Bluebell Railway in the UK***): ***when to show that you have learned what Reinhard has been talking about this morning, look at that picture on the wall there and make sure that your advertising for the railway has white smoke coming out of the***

chimney and our next version has got to have strawberries and grapes along the trackside.