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HEALTH AND SAFETY COMMISSION

TRAIN PROTECTION: ADVICE TO MINISTERS ON THE RAIL INDUSTRY'S PLANS TO INSTALL THE EUROPEAN RAIL TRAFFIC MANAGEMENT SYSTEM (ERTMS)

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ISSUE

1. The ERTMS Programme Board (EPB), jointly chaired by the Strategic Rail Authority (SRA) and Railway Safety, proposed that the rail industry work towards installing ERTMS (which will deliver automatic train protection) on Britain's high-speed rail lines by 2015, rather than by 2010 as recommended by the Joint Inquiry into Train Protection Systems (Uff/Cullen). Following our reviews of the EPB report, HSC needs to advise Ministers on the industry's approach and what, if any, regulatory or other action is needed to motivate delivery of the safety benefits of ERTMS.

TIMING

2. Urgent. Ministers are expecting the Commission's advice "early in 2003".

RECOMMENDATION

3. ➔ ←

BACKGROUND

4. Automatic Train Protection (ATP) prevents trains from over-speeding and from running passed signals set at danger. It intervenes automatically to slow or stop the train. ATP does not prevent all railway incidents - those caused by signalling errors or by problems with the tracks or trains, for example.

5. Both the Southall (1997) and Ladbroke Grove (1999) crashes would have been prevented by a working ATP system. (AWS[1] might have prevented the Southall crash, and TPWS[2] would have prevented the Ladbroke Grove crash.) After Ladbroke Grove,

[1] AWS - Automatic Warning System (See Annex 3)
[2] TPWS - Train Protection and Warning System (see Annex 3)

the Commission asked the Joint Inquiry into Train Protection Systems (Uff/Cullen) to consider:

i. Train Protection and Warning Systems

ii. The future application of Automatic Train Protection

iii. SPAD[3] prevention measures

taking account of the Southall and Ladbroke Grove accidents and the technical assessment for the Deputy Prime Minister of rail safety systems by Sir David Davies.

6. The Uff/Cullen report was published in March 2001 and HSC accepted its recommendations. It endorsed HSC's decision to make the Train Protection and Warning System (TPWS - see Annex 3) mandatory by 2004 (the Railway Safety Regulations 1999). Eleven of the report's 39 recommendations deal with fitting the European Train Control System (ETCS - the train control part of ERTMS) in the UK.

7. The Government welcomed the Uff/Cullen report. The then Minister of Transport (Lord Macdonald) said "The Government is (also) keen to see the new European train protection system introduced on our high speed network as soon as practicable", and a DTLR News Release added "The Government stands behind the categorical assurance given to Parliament last July by the Deputy Prime Minister that the Ten Year Plan will deliver measures arising from the inquiry."

8. More recently (19 November) Transport Secretary Alistair Darling told Parliament "the vast bulk of the Cullen and Uff recommendations after Paddington and Southall have been or are on the way to being implemented. Some issues, such as whether ERTMS should be fitted, are under discussion. When evidence was given to Cullen he was led to believe that there was an advanced European system that could be incorporated on our railways, but unfortunately it turns out that the system he had in mind does not work on any railway anywhere in Europe. It makes sense to evaluate systems to establish whether they would work, and whether they could be adapted for our railway system."

9. Uff/Cullen's most significant recommendations on ATP were that fitment of ETCS should be supported by Regulations (recommendation 18) expressed in absolute terms rather than dependent on reasonable practicability (recommendation 19) and in force by January 2004 (recommendation 20). Recommendation 21 and Annex 10 of Uff/Cullen set out the requirements and objectives to be achieved by Regulations (see Annex 5).

10. The railway industry's ERTMS Programme Team (EPT) was established after the Uff/Cullen report was published to produce "the Industry Plan for the implementation of ERTMS in the UK". The ERTMS Programme Board (EPB), jointly chaired by the SRA and Railway Safety, oversaw its work. HSE (like DfT and ORR) had observer status on the EPB. These arrangements continue.

11. HSC received the EPT's report in April, and the EPT's Director, David Waboso, and Rod Muttram of Railway Safety, Joint Chair of the EPB, gave a presentation to the Commission on 16 April 2002. The EPT's summary report is at Annex 6. Their full report is available if needed. The work of the team is continuing, at least until April 2003 when an updated report may be issued. This ongoing work is not thought to

[3] SPAD - Signal Passed at Danger

have departed radically from the conclusions published last April and suggests that ERTMS Level 2 technology could not be developed any earlier than 2008.

12. Annex 2 gives more information about the history of ATP on Britain's railways, the implications of European Directives on railway interoperability (which require ERTMS to be fitted in the long term anyway) and about the Government's 10-year plan for transport.

ARGUMENT

13. In May 2002 the Commission asked us to review the EPT Report, and to carry out work to assess current public attitudes to ATP and railway safety generally. Contractors - NEL (National Engineering Laboratory) and NERA (National Economic Research Associates) - led consortia to look respectively at technical and economic issues. Their reports are at Annexes 7 and 8. PSP (People Science and Policy Ltd) carried out the public attitude work. Their report is at Annex 9. In addition we sought responses (self selected and therefore unrepresentative) from our web page on ATP issues. These are analysed at Annex 10.

Public Attitudes

14. The public attitude project managed by PSP (Annex 9) involved an "expert" forum, a series of regional workshops sampling views of around 100 people, and a deliberative conference of stakeholders and a dozen workshop participants. The process concluded:

- people assume that railways provide a safe means of transport;
- people's first safety concerns are usually personal security, vandalism, anti-social behaviour and overcrowding;
- structural issues were seen as inhibiting the effective development of safety strategies, whether ongoing activities such as maintenance or major investments such as train protection;
- these structural issues were seen as related to the fragmented nature of the railway industry and the lack of clear leadership, strategy and national standards to provide greater coherence;
- HSC/E was seen as having an important role to play in providing this leadership in relation to safety issues;
- Most of the public participants at the deliberative conference preferred the package of benefits offered by Level 2;
- But at all the workshops and at the conference there were people who thought earlier availability of Level 1 made it a more attractive option;
- industry could not be trusted to devise and follow through an implementation plan without a regulatory framework providing an element of compulsion ie legislation with milestones against which progress could be measured.

15. The National Consumers Council's recently published research ("Running Risks - summary of NCC research into consumers' views on risk") suggests that consumers feel that government handles the issue of rail accidents particularly badly (the research took place around the time of the Potters Bar crash), and that there is a lack of trust in government on risk issues generally.

Economic Review

16. The Economic Review (Annex 8) argues strongly against health and safety regulation for ERTMS. They contrast HSC/E's view that societal risk/concern, while it cannot usefully be given an explicit economic value, should be factored into any cost benefit assessment, with the SRA approach of taking decisions based on 'affordability' or business case. They identify weaknesses in the EPT's conclusions on the capacity reduction impact of Level 1 and consequent rail to road modal shift. Nevertheless they accept that early implementation, if it resulted in a 10% loss in railway capacity, would probably increase transport fatalities, but only marginally (2 to 3 fatalities per year). They observe that non-safety impacts of modal shifts - for example road congestion - may be substantial, favouring Level 2 ERTMS. They also conclude that:

- the Uff/Cullen timetable for ERTMS is not robust
- it is premature to consider regulation of an alternative timetable
- much more strategic analysis is needed to inform decisions on ERTMS
- Level 2 ERTMS has the potential to offer much more than the safety benefits of ATP, including improved capacity, speeds over 125mph, and a more competitive supply market
- it is not yet possible to predict when Level 2 might be developed into a form suitable for our mixed traffic high capacity railway
- the rail industry's capacity and culture is a barrier to ERTMS development and the EPT's work
- TPWS+ fitment, already planned, should be brought forward
- based on historical evidence, with TPWS/TPWS+ only there would remain a 1 in 10 annual probability of a fatal ATP-preventable accident, with an average of 4 fatalities; with ERTMS (any level) this would reduce to 1 in 60 years;
- early fitment of unproven ERTMS technology risks an ERTMS-induced accident
- speed restriction should be considered as a train protection option.

Technical Review

17. The Technical Review (Annex 7) was effectively a document review of certain parts of the EPT report and unpublished background data, focussed on 13 questions set by HSE. Those involved had limited experience of – and thus complete independence from - the UK rail sector. Although they did not co-operate with the economic review to the extent we hoped, and were largely unable to take account of ongoing work by the EPT, nevertheless their conclusions are similar to those of the economic review:

- ERTMS Level 2 is at an early stage of development and because of this the risks associated with its implementation are not fully understood
- ERTMS implementation's impact on network capacity needs further investigation - there is inadequate evidence to support projected modal shift from rail to road, thus this argument against Level 1 is not sound
- the high degree of project risk for Level 2 at this stage has not been given sufficient weight. The totality of safety risks to passengers and trackside workers during

installation and the transfer of safety critical functions from trackside to trains has not been adequately addressed.

- the improvement in safety from the installation of TPWS/TPWS+ means the relative safety benefit of early ERTMS implementation (ie. Level 1), even at capacity pinch points on the network, is substantially reduced.

Europe

18. The Interoperability Directives, through their legally binding Technical Specifications for Interoperability (TSIs), make fitting ERTMS mandatory for projects relating to new lines, upgrades and major renewals for designated high speed and conventional rail routes (though there is scope for derogation). A proposal to extend the requirements of the Interoperability Directives to the entire heavy rail network in each Member State is currently under negotiation. The EU's Common Transport Policy mentions the need to create a single European railway system by 2020.

19. A varying picture on other countries' progress is painted. Since May we have gathered and compared information from suppliers, other rail inspectorates, Transport Ministries, the European Commission and the media. It is clear that progress of ERTMS development elsewhere in Europe has been far slower than expected at the time of the Joint Inquiry. There is certainly no question of this country being denied proven ERTMS technology that is already being rolled out across Europe. The EPT considers that progress this year has not matched expectations at the time of their April 2002 report. They report that a new high-speed line in Spain will be fitted with level 1 rather than level 2 because, even for a new dedicated high-speed line, the technology remains unproven.

20. Of course, unlike in this country, ATP already exists on many other Member States' rail networks and the drivers for ERTMS development are therefore interoperability and capacity enhancement, and not safety benefit. A consultant from Germany who took part in the technical review confirmed lack of enthusiasm by the industry there, for precisely this reason. Ironically the Swiss, outside the EU, have been one of the first to trial Level 2 ERTMS on a working railway, with limited success to date, though contrary to some reports they intend to continue with their project.

21. We have heard of a number of examples of European railways eg. Italy proposing migration of their existing ATP systems to forms of ERTMS that are only partially interoperable, some way below full compliance with harmonised European technical standards.

22. European investment contributed £10M towards development of the train control element of the West Coast upgrade. Railtrack contracted with a single supplier, ALSTOM, which has several other European projects. There is a question as to whether this approach has provided value for money, and evidence of progress is unclear. The EPT have not been able to gain as much benefit from the project as had been hoped. Client/ contractor sources have until recently been claiming earliest availability of the train control system as 2004/05, but when pressed do not dispute the 2007/08 date suggested by Bechtel's review of the West Coast project for SRA (which informed SRA's strategy discussed in HSC paper 02/139). Given that technical specifications will change and a single supplier is being used, "full interoperability" will probably not be achieved, though final delivery of the train control system would provide full ATP and line speeds up to 140 mph.

Regulatory context

23. Annex 2 details the current regulatory context for the HSC's decisions. There is already a range of UK regulatory requirements relevant to ATP. Most significantly, Sections 2 and 3 of the Health and Safety at Work Act 1974, the Railway Safety (Miscellaneous Provisions) Regulations 1997 and the Railway Safety Regulations 1999 all require (either implicitly or explicitly) that ATP is provided so far as is reasonably practicable. In addition, regulations implementing a European Directive require ERTMS to be fitted whenever high-speed lines regarded as part of the Trans-European Network[4] are upgraded.

24. All parts of the industry regard the regulation-led programme for fitting TPWS, required by the Railway Safety Regulations 1999, as a success. At first sight this could provide a model for regulating for ATP. However, we have learnt from these regulations the difficulty of regulating for technology, like ERTMS, that is under development. The over-ride prevention requirements of the 1999 regulations in respect of Mark 1 rolling stock relied on technical solutions that, though well researched in concept, proved to have unforeseen snags - including safety disbenefits.

Economic context

25. The economic context for Commissioners' decisions is not entirely helpful. Though Ministerial assurances about the 10 year Transport Plan and its capacity to deliver the Uff/Cullen agenda (see para 7) are helpful, it is clear that there are now great pressures on SRA and the rail industry to bring expenditure under better control. The "mood music" around the industry is that we are entering a period of financial stringency - including possibly some significant reductions in public subsidies. ERTMS will need to justify its place within the Government's and industry's spending priorities.

Decisions for the Commission

26. The Commission needs to decide:

    i. whether ATP remains a priority for railway safety, particularly given that TPWS, when fully installed, will prevent at between 65% and 80% of ATP preventable accidents (with TPWS+ delivering a further 4% to 8%);

    ii. if ATP remains a priority, whether ERTMS is the way to deliver it;

    iii. if ERTMS is the right way to deliver ATP, whether to take a view now on the most appropriate level. Should the aim be earlier installation of available technology (which implies Level 1, possible capacity reductions (although not as great as the EPT suggested), greater expenditure, and lack of political/industry support) or the most economic installation of partially developed technology as and when proven (which implies Level 2, capacity increases, (probably) less expenditure and later installation, and has political/industry support); and

    iv. how best installation of ATP should be encouraged by HSC/E, particularly given the structural changes in the industry since the Joint Inquiry.

<u>Does ATP remain a priority</u>?

27. Our view is that ATP remains a priority for the railways, particularly if there remains an aspiration to move to speeds above 125mph. ATP would have prevented 31 (40%) of the 77 fatal collisions, derailments and overruns on the national rail system between

[4] The West and East Coast Mainlines, the Channel Tunnel Rail link and the Great Western Mainline

1975 and 2000, saving almost half (86) of the 179 lives lost. [Source: HSE Contract Research Report 334/2001]. The history (including commitments made by Ministers), the Uff/Cullen recommendations, and public expectations all support ATP.

28. Fitting TPWS (and the potential fitment of TPWS+) has weakened the commercial case for ATP but this does not alter the fact that, particularly on high-speed lines, effective ATP is the best way to avoid potentially disastrous high speed SPADs. The reduced effectiveness of TPWS above 75mph, and of TPWS+ above 100mph, is an important argument for ATP, particularly on high-speed lines.

Is ERTMS the way to deliver ATP?

29. ERTMS is the only available route to achieve ATP on British railways. Alternatives (such as the form of ATP on the Chiltern and Great Western Lines or the variant of French ATP being fitted on the Channel Tunnel Rail Link) would, in the context of the Interoperability Directives, be illegal.

ERTMS Level 1 or Level 2?

30. The next question is whether or not the Commission should accept the rail industry's view that later installation of ERTMS Level 2 is preferable to earlier installation of ERTMS Level 1. Annex 4 tabulates the EPT's conclusions together with the results of the technical and economic reviews of the EPT's report.

31. From the Commission's perspective, the debate about the type of ERTMS appropriate for British railways is secondary to the fact that both Level 1 and Level 2 deliver ATP, which is our objective. The Commission needs to focus on how best to ensure that ATP is provided as quickly as feasible on the lines where it is needed - particularly high-speed lines. As the capacity benefits of ERTMS Level 2 make it the better economic ATP option for most of the network, it would be politically contentious for the Commission to insist on Level 1, even if it might be delivered 5 years sooner.

32. We suggest that HSC should not comment on the relative merits of Level 1 or Level 2 ERTMS. Both deliver ATP, which is what we seek. It is for the industry and its Government sponsors to decide the type of ERTMS which best suits the British rail network.

How best to encourage ATP Implementation?

33. The final question is how HSC/E can best encourage implementation of ATP. Options are constrained by the fact that, unlike Uff/Cullen, the Commission must adhere to the principles of regulatory impact assessment for any proposed regulations. While it might be possible to suggest other incentivising or regulatory levers (such as use by DfT of Transport Act 2000 powers to make directions to the SRA or modifications by ORR of its Network Code) HSC can only propose formal regulation within the vires of HSWA.

34. Using health and safety regulation on this issue is difficult. Based on the EPT's assessment, the cost of preventing each fatality by installing ERTMS is either £75 million (Level 1 to the Uff/Cullen timetable) or £45 million (Level 2 to the EPT timetable). Conventionally, at least for road improvements, the DfT regards the value of preventing a fatality as being around £1 million, and this figure is broadly supported by HSE funded research into public attitudes (*Valuation of benefits of health and safety control: Follow-up study*, HSE Contract Research Report 315/2001).

35. Professor Uff and Lord Cullen felt that they were not "called on to come to any judgement on whether these systems (TPWS and ERTMS) satisfy a cost benefit

analysis" because the systems were already mandated by law (the High Speed Interoperability Directive, in the case of ERTMS - see Annex 2). (para 4.30 of Uff/Cullen) In practice any new regulatory requirements would require properly quantified impact assessments.

36. There are two regulatory drivers already "pushing" ATP, the Railways (Interoperability)(High Speed) Regulations 2002 and the Railway Safety Regulations 1999 (see Annex 2). Both have limited effect.

37. The Interoperability Regulations (like the Directive) include no timescale for implementation and wide power to issue derogations from TSIs. Derogations can be granted by the SRA where a project was in an advanced state of development when the regulations were introduced (as some could be argue with the West Coast Mainline renewal). In other circumstances, such as where compliance with the regulations would compromise the economic viability of an upgrading project, the SRA would need to seek the permission of the European Commission before granting a derogation. SRA is required to consult HSE on the safety implications of any proposed derogations.

38. The Railway Safety Regulations require ATP where this is reasonably practicable. It is arguable that the prevalence of ATP systems on higher speed lines in other countries means that ATP is "reasonably practicable" on the basis of international good practice. This would be consistent with our approach in "Reducing Risk, Protecting People". It is difficult to be sure that the courts would accept this argument, however.

39. On the conventional "gross disproportion" test of reasonable practicability, there is no doubt that the costs of installing ATP in the UK are well in excess of the safety benefits. Only the courts can decide finally whether the excess represents "gross disproportion". HSE may eventually need to decide whether, when and how to test this issue before the judiciary by means of a prosecution.

40. If HSC recommends regulations on ATP that go beyond reasonable practicability, we will need to provide convincing arguments that the costs of doing so are fully justified by, for example, societal concern as expressed by the likely political or other consequences of major ATP preventable rail disasters. The Government's commitment to "bring within" their 10 Year Plan for Transport "any further measures arising from the joint inquiry" (Annex 2, para 6), does not mean that we should seek to avoid a full Regulatory Impact Assessment. We have commissioned further research on the frequency of high fatality events on the railways, for comparison with other sectors where societal concern has been an issue. This should be available for discussion at the Commission meeting on 14 January 2003.

<u>Policy Options</u>

41. With all that said, we have identified the 9 options outlined in Annex 1, some of which can be combined. The options we judge worth considering are:

    i. (B) accept and formally endorse the EPT report and its timescales, with **no regulation at this stage** but with (C) **periodic review** of progress by HSC/E;

    ii. (D) Initiate a formal, public agreement between HSC/E, ORR and SRA (and DfT on behalf of Government) on a **national strategy** for delivering ERTMS, with (C) **periodic review** of progress by HSC/E;

iii. (F) **regulations** to require fitting of ERTMS on high speed lines to a defined timetable and/or a speed restriction (I) where ATP is not fitted;

iv. (G) more **regulation** for existing (TPWS/TPWS+) technology as an interim measure – could be combined with periodic review (C) and speed restriction (I);

The criteria we have used to assess the available options are:

- The probability of achieving the policy objective
- The acceptability of the option to:
  - Government
  - railway users
  - railway industry employers
  - other Government departments and agencies concerned with the railways - particularly SRA and ORR
  - taxpayers
  - railway employees/unions
  - survivor and railway safety pressure groups
  - the enforceability of the option (particularly of the regulatory options), given that the penalties likely to be imposed by the courts may not motivate compliance with a very expensive investment programme.

42. Option A takes ERTMS completely out of the 'safety box'. Though this reflects the reality of the economic/safety case the absence of HSC/E involvement in the issue would be unacceptable to the public, and would diminish the likelihood that ATP will be delivered.

43. Option B demonstrates publicly HSC/E's support for the industry's plans, but it has no real regulatory bite, unless combined with other option(s) such as E.

44. Option C defers a decision on regulation until lack of progress, as demonstrated by HSC/E annual or periodic reviews of industry progress, makes regulation necessary.

45. Option D - agreement between HSC/E, ORR and SRA (and DfT on behalf of government) on the process for delivering ERTMS and monitoring and reporting publicly on progress) - has the advantage of recognising both the economic and the safety benefits of ERTMS. It reinforces our determination to ensure delivery by committing all parties to continued public scrutiny on the issue. Against that, arguably it takes us little further forward than the position reached in 1994 when the then Commission Chairman observed that the Commission regarded as a "minimum response to the need" BR's view that ATP or Automatic Train Control would be adopted as standard on new high speed lines and would be given "full consideration" when there is major resignalling. (See Annex 2).

46. ➔ ➔

47. Option E is regulation to the timescales proposed by industry in April 2002, and shares the difficulties associated with regulating to the Uff/Cullen timescales (see Option F).

48. Option F is the Joint Inquiry proposal, with the strengths and weaknesses that implies, but limited only to the high-speed lines. The strengths are that Uff/Cullen considered all the issues and reached a view that the Commission accepted at the time. The

weaknesses are that the evidence Uff/Cullen considered - particularly on the state of development of ERTMS - has proved far too optimistic. It remains possible that even a long and expensive development process may not deliver a Level 2 system capable of operating in the UK. Compatibility with the planned GSM-R voice-data communications system (which is key to Levels 2 and 3) is a key technical risk. We are not able, for legal reasons, to make regulations requiring the development of ERTMS. Without assurance that ERTMS works it would be inappropriate to make regulations requiring it.

49. The assumption made by Uff/Cullen that no consideration needs be given to cost/benefit issues in pursuing a health and safety regulatory approach was unfortunate. However, it is in the interests of the railway industry that there is a clearly defined and generally accepted programme for ERTMS fitment. When the Commission can be sure that ERTMS is a proven technology, regulation might provide a mechanism for providing this certainty. If regulation focussed only on the high-speed lines, it is possible that a Regulatory Impact Assessment which took appropriate account of societal concerns could support this approach, even though the "headline" cost of preventing a fatality might be very high.

50. Option G recognises that TPWS and, particularly, TPWS+ have the potential to further mitigate ATP preventable risk. The industry is already exploring using the technology in circumstances beyond those prescribed by the 1999 regulations.

51. Option H recognises that we already have a statutory lever (the 1999 regulations) to enforce provision of ATP, so long as the costs involved are not "grossly disproportionate" to the safety improvements achieved.

52. Option I recognises the relationship between train speed and the need for ATP, either by greater use of existing powers to enforce permanent speed restrictions in specific locations, or by proposing regulations to restrict train speeds where ATP systems are not used. This option is recommended for consideration by our Economic Review team.

Conclusion

53. ➔ ←

CONSULTATION

56. There has been widespread consultation with a full range of stakeholders. SRA, DfT and the Rail Passengers Council were represented on the HSE review project board. A full programme of meetings involving the Chair, Margaret Burns and HSE officials have been held with representatives from the SRA, ORR, Treasury, DfT, Railtrack/Network Rail, RIA, ALSTOM, ASLEF, RMT, Scottish Executive, National Assembly for Wales, Commission for Integrated Transport, PACTS, ATOC, Railway Safety, ERTMS Programme Team, Heritage Railway Association, Rail Passengers Council, Victim and Survivor Groups. In addition a web page www.hse.gov.uk/railway/atp was prepared to encourage the public to express their views.

57. RIAC will consider this paper at a special meeting on 9 January.

58. Annex 11 summarises stakeholder views and Annex 10 the 89 self-selecting responses to the web page received to mid-December. At least 35 of these came from within the rail industry and specialist media.

PRESENTATION

59. While it has been difficult to generate media interest specific to ERTMS and train protection there will be political and media interest in the Commission's views. This will be against the backdrop of December's DfT 10 Year Transport Plan progress report with its focus on a safe and reliable railway, with immediate priorities of better performance to improve quality and reliability; to bring costs firmly under control; and to secure improved use of existing capacity. The SRA's media briefing that 'improvements to the rail network will be abandoned unless industry improves performance and cuts costs' is a message likely to be followed through in the SRA Strategic Plan 2 in late January. The Chair plans to brief the press, taking the line 'safety will not be forgotten as SRA prepare their plans'. A presentation of research findings was made to stakeholders on 17 December. Slides used by the presenters are attached. The three reports (Annexes 7-9) will be issued as HSE Research Reports in the usual way.

60. Current conventions mean that the Commission's advice to a Secretary of State must remain confidential. Nevertheless, much of this paper can be "Open". Only the recommendations (para 3), the views of consultees where they have asked for or would legitimately have expected confidentiality, the conclusion (paragraphs 53-55) and Annex 11 are "Closed".

61. We recommend that the Commission's views on the EPT Report should first be presented to DfT and DWP Ministers at a meeting. We will continue discussion with ORR and SRA officials to prepare the ground.

COSTS AND BENEFITS

62. The economic review (Annex 8) highlights (table 7.1 - page 33) extremely high installation costs for ERTMS on present information, and the lack of a competitive supply market to bring them down. The review also highlights possible reasons for 'cost creep' (known in the industry as the 'Ford Factor') in major rail projects. Railtrack's TPWS programme, for example, has cost well over £500M rather than the £100-140M estimated when the 1999 Regulations were made.

63. Apart from the safety benefits of ATP (above those already provided by TPWS and potentially by TPWS+) the potential benefits that could flow from the major changes to signalling and train driving involved, would include improved capacity and communications, better management of track "possessions", and speeds above 125mph.

FINANCIAL/RESOURCE IMPLICATIONS FOR HSE

64. External research costs for this review have been in the region of £430k, a significant call on HSE's major hazards research budget. Should the Commission favour periodic review, any further consultancy eg. technical or economic review would need to compete against other research priorities, and indeed wider resource pressures on HSE.

ENVIRONMENTAL IMPLICATIONS

65. If ERTMS results in increased rail capacity, any consequent shift of passengers and freight from the roads (and from air) to trains will result in environmental benefits.

OTHER IMPLICATIONS

66. The Scottish Executive and the Welsh Assembly have been consulted as part of this process, and accept that this issue is not devolved. Like most of those consulted, both

would regard as a bad thing any action that made railways less economically competitive with other transport modes.

ACTION

67. When the Commission has agreed its approach, a meeting should be arranged for the Chair with Alistair Darling (who would take a DfT/SRA brief) and Nick Brown (who would take an HSE/DWP brief). A date will be canvassed for late January. The SRA chairman Richard Bowker and the Rail Regulator Tom Winsor will need to be involved or seen separately. Formal correspondence could follow. DfT would expect Mr Bowker to be involved before advice is put to Alistair Darling.

Index to Annexes

Annex 1

Regulatory and other options considered

Option	
A	**Not really about safety** Accept that the safety benefits of ERTMS are marginal, inappropriate for health and safety regulation, and leave industry/Government to comply with interoperability regulations
B	**Agree with industry analysis** Endorse the EPT Report and its timescales, but without regulatory or other action by HSC/E.
C	**Periodic review** Industry progress subject to formal (annual?) public review by HSC/E.
D	**National strategy** Formal, public agreement between HSC/E, ORR and SRA (DfT on behalf of Government?) on ERTMS development strategy, together with commitment to delivery.
E	**Regulations to support EPT report conclusions** Health and safety regulations to require ERTMS Level 2 (as recommended by EPT Report) to be developed (and/or installed) to a defined timetable.
F	**Regulations for ERTMS on high-speed lines** Health and safety regulation to require ERTMS to be fitted to high-speed routes by specified date(s).
G	**More regulations for existing technology** Health and safety regulation for further fitment of existing technology, TPWS and TPWS+ to further reduce ATP-preventable risk.
H	**Use / reinforce existing ATP requirements in 1999 regulations** Take a more robust line on whether level 1 ERTMS fitment is “reasonably practicable” now on some major resignalling projects and level 2 as soon as proven technology is available
I	**Regulation for speed restriction where ATP not fitted** Reduce ATP-preventable risk by limiting train speeds in line with TPWS / TPWS+ effectiveness – 75-100 mph ?

Option	Strengths	Weaknesses	Other factors/issues
A Accept that the safety benefits of ERTMS are marginal and leave it to SRA, ORR and the industry to secure resources and deliver.	• Recognises that there may be only a limited safety case for ATP, now that TPWS is being installed • Acceptable to the industry (and the Treasury?)	• Ignores Uff/Cullen entirely • Unacceptable to HSC • Unacceptable to survivor and railway safety pressure groups • HSC/E's position would be indefensible if an ATP preventable collision occurs	
B Accept/endorse the EPT Report and its timescales, but without regulatory or other action	• Obviously acceptable to the industry • Would (on current plans) deliver ATP on high-speed lines by 2015, and on the entire network by 2030. • HSC endorsement would increase the probability that public funding would be forthcoming. • Interoperability requirements have potential to ensure eventual delivery • HSC/E would retain the option of making regulations later	• No assurance that industry will deliver. • Departs from timetable (Uff/Cullen) previously accepted by HSC and welcomed by Government. • Acceptability to HSC? • Acceptability to passengers groups? And to pressure/victims groups? • Application and effectiveness of interoperability regulations not clear? (eg definition of "upgrade", & scope for "economic" derogations)	• Relies only on industry's commercial case to obtain Government funding
C Formal (annual?) periodic review of industry progress by HSC/E	• Acceptable to industry • Allows technical progress to be further reviewed • HSC/E would retain the option of making regulations later	• Acceptability to HSC? • Acceptability to survivor and railway safety pressure groups, unions? • Lack of precedent in other industries regulated by HSC/E	• Regulation of a development phase cannot be supported by HSWA regulation

Option	Strengths	Weaknesses	Other factors/issues
D. Formal, public agreement between HSC/E, ORR and SRA (and DfT SoS on behalf of Government?) on developing and delivering.	• Recognises that the major benefits of ERTMS are economic (increased capacity, etc) rather than risk-related • Publicly commits the health & safety and economic regulators, and the sponsoring agency (and department?) to an agreed approach • Flexible, though the probable lack of publicly agreed dates for delivery would need careful handling • Acceptable to industry • Gives HSC/E a (weak) lever if progress slips • HSC would retain the option of proposing regulations later • ORR and SRA motivated to use their respective powers to help progress ERTMS	• Acceptability to HSC? • Acceptability to survivor and railway safety pressure groups? • No real teeth if political will (or public money available) to deliver reduces • Depending on nature of the agreement, risks committing industry to deliver unproven technology	• Possible lack of DfT/Government buy-in at least until 2004 Spending Review • Similar to the (discredited?) approach adopted after the Hidden inquiry into the Clapham crash

Option	Strengths	Weaknesses	Other factors/issues
E. Use health and safety regulatory powers to require ERTMS Level 2 to be developed (and/or installed) to a defined timetable.	• Acceptable to survivor and railway safety pressure groups? • Ensures ERTMS is developed • HSC would retain the option of proposing regulations later to require fitment of the developed technology	• Unacceptable to HSC? • Regulatory Impact Assessment (RIA) unlikely to support this • Lack of direct safety benefit - no power under HSW Act to make regulations requiring development • Defining the specified date(s) difficult (impossible?) • Likelihood of need to amend/ extend deadlines • How to revise deadlines?	• Industry's commercial case to obtain Government funding reinforced by a regulatory requirement (this is not an argument that can be used to support the need for regulation)
F. Use health and safety regulatory powers to require ERTMS to be fitted to either high speed lines (or all network) by specified date(s).	• Acceptability to HSC • Acceptable to survivor and railway safety pressure groups? • Clarity for all parties • Follows the Uff/Cullen recommendations	• Regulatory Impact Assessment (RIA) unlikely to support fitment to all of the network, but societal concern may mean that high speed line fitment is a viable option • Regulations would require as yet unproven technology, unless they specify level 1 and we accept the consequent capacity reductions. • Defining the specified date(s) difficult • Likelihood of need to amend/ extend deadlines • How to revise deadlines?	• Industry's commercial case to obtain Government funding reinforced by a regulatory requirement (this is not an argument that can be used to support the need for regulation)

Option	Strengths	Weaknesses	Other factors/issues
G. Regulation that existing technology (TPWS & particularly TPWS+) is extended until all ATP preventable risks are effectively eliminated.	• Achievable using proven technology • Delivers HSC/E's objective on preventing SPAD related collisions • Builds on approach of the TPWS elements of the Railway Safety Regulations 1999 • We know that the technology works, is available and may be "SFAIRP" • Regulatory Impact Assessment might justify the option • Acceptable to survivor and railway safety pressure groups, given that ERTMS Level 1 doesn't provide continuous ATP? • TOCs/ROSCOs would have no difficulty - all vehicle borne kit already required by 1999 regulations	• Ignores Uff/Cullen analysis and conclusions on ATP, though the Joint Inquiry did recommend that TPWS+ be pursued. • Unacceptable to industry, SRA and DfT (and ORR?) • Doesn't deliver "real" ATP, or deliver the same standard of risk control as ATP • Would restrict railway maximum speeds in UK to 125mph • Would restrict railway capacity? (or at least not increase it) • Increased risks to track workers? • Consumes large signalling resource needed to comply with Interoperability requirements	• Level playing field between ATP lines and those with AWS/TPWS only? • Industry will fit some TPWS+ anyway eg to ensure approval of new rolling stock (Pendolinos?) • May divert resources from ERTMS development and other key signalling projects
H. Enforce (or reinforce through revised regulation) existing ATP provisions in 1999 Railway Safety Regulations	• Uses existing regulation when HSE consider ERTMS reasonably practicable • No additional regulatory impact assessment	• Justification of reasonable practicability could be challenged • Penalties for non-compliance would be minimal compared with cost of ERTMS	•

Option	Strengths	Weaknesses	Other factors/issues
I. Regulation for speed restriction where ATP is not fitted – to speeds where TPWS and TPWS+ are effective	• reduces ATP preventable risk in the period prior to ERTMS • eliminates risk of high-speed collision above 100 mph • reinforces existing RI use of speed restriction where ATP not fitted to trains eg. GWML	• increases journey times , possibly to the point where certain long distance services become uneconomic • speeds up to 125 mph without ATP are tolerated now • HSE open to criticism of 'risk aversion' • Probably inacceptable to industry , Ministers and RPC ?	•

Annex 2

Automatic Train Protection: Background and current legal requirements

Background

1. In 1985 the Chief Inspecting Officer of Railways called on British Rail (BR) to consider a system of ATP. In previous reports he had pointed out that while great improvements had been made in the signalling system, the driver had been left without any additional technical aids. Developing ATP became BR policy in 1988.
2. In November 1989 the Hidden Inquiry into the Clapham crash welcomed BR's commitment to introducing ATP on a "large percentage" of the network, but was concerned about the timetable. The report recommended that "after the specific type of system has been selected, ATP shall be fully implemented within 5 years, with high priority given to densely trafficked lines."
3. Though BR had accepted the Hidden recommendation in principle, in March 1994 (just before Railtrack took over as infrastructure controller) they delivered a report to the Secretary of State for Transport setting out their conclusions on ATP's financial (non) viability. The Secretary of State sought HSC's views in May 1994.
4. On 23 December 1994 the then Chairman responded - see attachment - expressing what the Southall Inquiry report called "qualified support" for BR's conclusions. The Southall report says "Further correspondence followed between the Secretary of State and the Chairmen of Railtrack and HSC in which reference was made to new safety initiatives with Railtrack's SPADRAM (SPAD Reduction and Mitigation) project, including TPWS. Finally the Secretary of State on 29 November 1995 made a statement listing the safety measures being pursued by Railtrack and BR, with (according to the Southall report) "ATP being limited to the two existing pilot schemes and main line re-signalling projects."
5. The most significant main line resignalling since 1995 (see para 4) has been the West Coast Mainline (WCML) Modernisation. This was scheduled to provide ERTMS (and hence ATP) by 2007. On 9 October 2002 the Strategic Rail Authority (SRA) published a consultation document on a revised approach to the WCML project, and HSC considered its response on 3 December 2002 (Paper HSC/02/139).
6. In July 2000 the Government published its 10-year plan for transport. This envisages a 50% increase in rail passengers and an 80% increase in rail freight by 2010. Chapter 7 of the Plan says "Investment in rail safety will be a priority for the Government and the industry. ……. More must be done to restore the public's confidence in the safety of rail travel." (para 7.6), and "The Plan envisages the industry …. fitting full automatic train protection on higher speed lines as they are upgraded, as recommended by Sir David Davies' report on train protection. …… We will bring within the Plan any further measures arising from …. the joint inquiry by Lord Cullen and Professor Uff into train protection systems." (para 7.8)

Current Legal Requirements

7. Railway operators, like all employers, must ensure the safety of the public, so far as is reasonably practicable (Section 3 of the Health and Safety at Work etc Act 1974).
8. In addition, the Railway Safety (Miscellaneous Provisions) Regulations 1997 require railway infrastructure controllers to ensure, so far as is reasonably practicable, that

equipment and procedures are in place to prevent collisions between vehicles and with buffer stops, and derailments resulting from excessive speed or incorrectly set points.

9. The Railway Safety Regulations 1999 require that “no person shall operate, and no infrastructure shall permit the operation of, a train on a railway unless a train protection system is in service in relation to that train and railway.” (Regulation 3(1)) Though this duty is not qualified by “SFAIRP”, the regulations’ definitions mean that the system required is TPWS unless it is reasonably practicable to install full ATP.

10. In 1996 the EU agreed the so-called “Interoperability Directive” (96/48/EC). The Railways (Interoperability)(High Speed) Regulations 2002, which came into force on 16 May 2002, implement the Directive in the UK. HSE is the enforcing authority, though the regulations were developed and introduced by DfT. The Regulations require that ERTMS be fitted whenever so-called “Trans European Network” (TEN) high-speed lines are upgraded, but there is great scope for derogations from the regulations, particularly if compliance would make upgrades uneconomic. The regulations apply to the West Coast Main Line, East Coast Main Line, Great Western Main Line and the Channel Tunnel Rail Link.

11. The Conventional Rail Interoperability Directive (2001/16/EC) is expected to be implemented by 2003/4 (dependant on technical standards being developed) and will make ERTMS compulsory on all main line and high speed lines, when the signalling is renewed or upgraded.

HSC
Health & Safety Commission
From the Chairman
Frank J Davies CBE OStJ

The Rt Hon Brian Mawhinney
Secretary of State for Transport
Department of Transport,
2, Marsham Street
London SW1P 3EB

23 December 19

Dear Secretary of State,

AUTOMATIC TRAIN PROTECTION

John MacGregor wrote to me last May requesting the Commission's advice, by the Autumn, on the report by British Rail (BR) on Automatic Train Protection (ATP) and on the issue of the values to be placed on a statistical life for safety investment purposes. I am pleased to respond.

In its consideration of the report, the Commission had very much in mind the need to introduce systems to prevent accidents from signals passed at danger, overspeeding or buffer stop collisions These situations have the potential to cause catastrophic accidents. The recommendations of the Hidden Inquiry recognised this need. It is now five years since the report of the Hidden Inquiry was published and the Commission is concerned that actic is seen to be taken on its recommendations.

We are aware that, concurrently with our consideration of the BR report, the Railway Inspectorate (RI) have been engaged in technical discussions with Railtrack (who, as national infrastructure controller, now has the prime responsibility for deciding on action to improve the safety of track and signalling). These discussions have not so far produced any fir indication from Railtrack of their intentions as regards reducin or preventing the incidence of signals passed at danger, overspeeding and buffer stop collisions.

RI for their part have been independently considering what criteria they might apply to identifying parts of the network where measures to prevent these accidents are especially desirable and could be expected to yield value for money. We have asked HSE to report back by June 1995, on the progress that has been made in reaching agreement with Railtrack on such criteria, with an expectation of receiving a proposed strategy b that time.

Turning to the BR report, we are impressed by its openness and transparency, particularly the full statement of the data used; the clarity of the exposition, and the recognition of the important uncertainties. These have made it easier for us to assess the validity of the methodology used by BR and the

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robustness of the conclusions. We note that the report relates to a specific system of ATP ie that piloted on the Chiltern and Great Western Lines. The conclusions reached in the report therefore apply only to that specific system and its associated costs. They do not necessarily apply to the generic concept of automatic train protection by technological means to complement the vigilance of the driver. Our views that follow must be seen in that light.

HSE experts have examined the report and believe that BR's approach is basically sound. However, they have questioned some of the assumptions made and would have carried out some of the cost calculations in a different way. Experts from HSE, British Rail (BR), and Railtrack have met to discuss and resolve technical issues. The main outcomes are set out in the Annex. As you will see, there are no substantial differences of view on the technical issues raised by the report. However, the issue of alternatives to the piloted ATP systems, to which we have referred above, remains unresolved.

HSE has made it clear in those discussions that any conclusions based on the assessment of the costs and benefits presented in the report are without prejudice to the Commission's views on the need to introduce some system or systems for preventing the kind of accidents that ATP are designed to avert. It is, in our view, a case of horses for courses and decisions should be made on a judgement of whether ATP as piloted or some variant, or alternative measures are, in given situations, reasonably practicable. Sir Bob Reid's letter of 31 March 1994 to John MacGregor made clear that if responsibility lay entirely with the British Railways Board ATP or Automatic Train Control would be adopted as standard on new high speed lines including the Channel Tunnel rail link and will be given full consideration when Railtrack undertakes major resignalling works. The Commission regard this as the minimum response to the need and expect Railtrack to carry forward that undertaking by the British Railways Board.

The judgement on what is reasonably practicable can take as its starting point the philosophical framework (known as TOR) published by HSE for deciding which risks are unacceptable, tolerable and broadly acceptable. This has gained considerable acceptance within industry (including the railway industry) and has helped to provide the basis for justifying decisions whereby risks are judged to be worth the benefits.

The framework involves acceptance of an upper limit above which particular risk is regarded as unacceptable to HSE as a regulator. This upper limit is taken to be a chance of death of 1 in 1,000 per annum for workers and 1 in 10,000 per annum for members of the public.

Below the upper limit is a region where a balance has to be struck between the costs and demonstrated benefits of any

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The Tolerability of Risk from Nuclear Power Stations. HMSO 1992. ISBN 0 11 886368 1.

increment to the existing level of safety, ie, of risk reduction. There must of course be confidence that a risk is actually being controlled at the relevant level, known as ALARP (as low as reasonably practicable). The lowest point at which it would be considered sensible to address any risk would be where the chance of death was about one in a million per year.

The BR target of 1 in 100,000 per year for the overall risk of death to regular commuters, one of the most exposed group of passengers, is already being achieved. The global application of ATP would therefore address degrees of risk which are in the lower portion of the "ALARP" region. On the principles which HSE usually applies, this has two implications:-

(a) the value of life which has to be assumed in any balancing of cost and risk would not be enhanced by the factor of "gross disproportion" which is applied to risks further up the tolerability scale, or where the chance is particularly hard to estimate.

(b) it becomes reasonable to take into account the availability and value for money of alternative ways of making risk reducing investments.

An overall judgement as to the cost effectiveness of comprehensive application of any particular safety improvement will often mask situations where investment at particular locations may be cost effective while full application is not. In the case of ATP cost effectiveness at a particular location will depend on such factors as the frequency of services, the complexity of the system, and differing costs for more limited application.

Taking all these factors into account, HSE have told us that the introduction of ATP as piloted on a network-wide basis could not be regarded as reasonably practicable by the criteria they usually apply, and that there are alternative safety investments which would be likely to yield greater effectiveness in terms of lives saved, and better value for money. We endorse these judgements. However it would in our view be unreasonable to rule out the possibility that particular applications of ATP or indeed other automatic devices or other measures giving protection against ATP preventable accidents (ATPPAs) on parts of the network might yield good value in terms of reduced loss of life. We have taken into account, moreover, that there is a public expectation that automatic means of protection will be introduced at least on a partial basis, following the information given by British Rail to the Hidden Inquiry and the latter's recommendations five years ago and in view of developments on some foreign railways. The European Commission's intention to introduce a directive on the interoperability of the high speed network in Europe, and the indications that the need to reduce accidents from signals passed at danger will figure in their calculations is also a relevant factor.

The report refers to the prospects offered by alternative more advanced technology. The timescale for its possible introduction

is very uncertain and could be long especially bearing in mind the need to test and demonstrate any new system. At the same time, the emergence of modified and possibly cheaper versions of ATP than those so far tested by British Rail could lead to favourable outcomes in value for money terms, and should be pursued on an urgent basis.

Although Mr MacGregor invited us to do so, we would prefer not to pronounce on the vexed question of the value of life to be applied in such calculations. HSE have suggested that where catastrophic risk is concerned, the value cannot reasonably be less than three times the estimate which we understand your Department applies to situations of risk to individuals, and this conclusion was endorsed by Sir John Cullen in a letter to Mr MacGregor dated 9 November 1992. The BR report mentions for such applications a value of £3.5 million as a possibility. What does seem clear is that in any catastrophic accident, the damage in terms of public confidence, additional costs, and harms and risks to people quite aside from the number of deaths is substantially greater than damage connected with the generality of risks to individuals. While there may be two views about the rightness of factoring added costs to reflect this extra damage into the "value for life", and we would prefer not to enter into this essentially technical argument, it seems obvious that they need to be taken into account in some way; and it is clear to us also that whatever balance is struck, it needs to be firmly on the side of safety where doubt arises.

In this respect, chapters 8 and 9 of the report seem relevant. These place the risks of ATP preventable accidents in context with other risks and examine the effects that investing in ATP would have on overall safety on the railways if its introduction were to displace other safety investments. In the time available, it has not been possible for HSE to evaluate the conclusions reached in these chapters. The Executive has, however, asked HMRI to take these factors into account, as well as the balance of costs and risks - in relation particularly to new investments - when they explore with Railtrack the possible options available for tackling ATP preventable accidents and possible criteria for identifying parts of the network where measures to prevent such accidents could yield value for money.

As I said at the outset, we have asked for a report on the outcome of these discussions by June 1995. The report from BR has acted most usefully as a catalyst. We now need to move towards achieving a solution to what we regard as an issue of serious concern.

Yours sincerely

Frank J Davies CBE OStJ
Chairman

Annex 3

Description of the Automatic Warning System (AWS), the Train Protection and Warning System (TPWS) and Automatic Train Protection (ATP)

Automatic Warning System (AWS)

What It Is
Most basic form of train protection is the Automatic Warning System (AWS), which has been standard on the main railway network for many years. AWS was introduced to help drivers, particularly at times of poor visibility.

How It Works
Magnets are fixed between the rails about 200m before a signal. This activates a bell in the driver's cab if the signal shows a clear line ahead, and sounds a warning if the signal indicates 'caution' (single or double yellow) or 'danger' (red). If the driver fails to acknowledge a warning within a few seconds by pressing a button, the brakes are applied.

Effectiveness
AWS's effectiveness in preventing collisions is incomplete, because the warning can so easily be overridden. On busy lines and during peak periods where trains frequently proceed through successive yellow signals, the warning may sound so often that drivers may become desensitised to it and fail to respond to signals correctly.

Train Protection and Warning System (TPWS)

What It Is
TPWS incorporates AWS, but provides a higher degree of train protection. It will be fitted throughout the network by the end of 2003.

How It Works
Transmission beacons are placed on the track which can initiate emergency braking to halt the train if it is either about to pass a red signal (the 'train stop') or has exceeded a maximum permitted speed by more than a set margin (the 'speed trap').

Speed traps can be fitted at the approach to signals in order to slow down a train travelling at above the permitted speed sufficiently to avoid most of the more serious SPADs, where the train overshoots the signal by such a large distance as to cause an danger such as a collision or a derailment. They can also be fitted at other locations where a speed restriction is required, for example at the approach to buffer stops, sharp curves, or track under maintenance.

Unlike AWS, the driver cannot override the system. TPWS has been designed to be simple to fit to existing track and trains.

Effectiveness
Compared with AWS, TPWS will reduce the risk of collision or derailment significantly, but it gives less protection than ATP.

In particular, TPWS is unlikely to be totally effective if the driver of a train disregards caution signals and approaches a red signal at high speed.

TPWS's effectiveness depends on the siting of the speed trap relative to the signal, and the speed at which a train will be 'tripped'. Generally, the further back the detector is from the signal, and the lower the permitted speed at that point, the more effective the system will be in preventing serious SPADs.

The optimum siting of the speed trap is at about 450m from the signal. Because different trains have different braking performances, the further away from the signal the speed trap is located, the wider the range of acceptable speeds becomes. Care is needed to prevent the trap intervening unnecessarily when a train is being driven safely.

HSE and the railway industry believe that TPWS will prevent between 65% and 80% of equivalent fatalities due to ATP-preventable events.

TPWS+
This is a further development of TPWS that extends the range of speeds over which TPWS is effective by installing additional speed traps further back from the controlling signal.

Trials have been carried out and assuming a 183 metre overlap and 12% braking rate it has been calculated that this additional speed trap would need to be placed for a train travelling at 100 mph at a distance of 770 metres before the signal set to 75 mph.

Like TPWS, TPWS+ does not provide the same level of protection as ATP on lines where trains are operating with different braking capabilities or travelling at different speeds.

There is no regulatory requirement for fitting TPWS+ to the network but the rail industry, in consultation with HSE, is now considering the fitment of TPWS+ where appropriate

Automatic Train Protection (ATP)

What It Is
Automatic Train Protection is a system that ensures that trains comply with speed restrictions and prevents them passing red signals. With the advent of electronic technology in the 1980s, a number of much more sophisticated train protection systems have been developed which give a very high level of protection against collisions due to failure to obey signals, derailments due to excessive speed, and buffer-stop collisions. There are a number of such systems and they are collectively known as Automatic Train Protection (ATP).

How It Works
These systems generally monitor the speed of the train, and compare the train's speed with a safe speed which the system calculates on the basis of the train's distance from red signals, the braking characteristics of the train and other factors such as the gradient of the line. If this calculated speed, which is indicated on the cab display, is exceeded by more than a set margin, automatic braking is applied until the train slows down sufficiently.

Effectiveness
ATP should prevent the great majority of 'signals passed at danger' (SPADs) because it supervises the speed of the train on the approach to the signal. The driver cannot override the system.

ATP is operational in Great Britain on the Chiltern lines, the Heathrow Express and Great Western Main Line (Paddington to Bristol). It is also planned for the Channel Tunnel Rail Line.

Annex 4 : Summary table of EPT Report conclusions and HSE review findings

Issue	**Uff/Cullen** (as assessed by EPT April 2002 report)	**EPT** (April 2002 report preferred option)	**HSE Review Findings** (taking account of further EPT work during 2002)
ERTMS on high speed lines by	2010	2015	• Uff/Cullen timetable not robust • difficult to predict technical progress • barriers : industry capacity and culture, lack of competitive supply market, high unit costs • level 2 system unlikely any earlier than 2008 • risk of ERTMS created accident with such a major system change
ERTMS on all network lines by	2015	2030	
Which ERTMS Level	No view	Level 2	• different levels give same safety/ATP benefit • economic and technical reviews – level 2 • public sample : "we (but not all of us) want level 2"
Safety effect for passengers and on-board staff	Prevent approx 83 fatalities over 40 years	Prevent approx 74 fatalities over 40 years	• with TPWS and TPWS+ only, can expect on average 1 ATP-preventable fatal accident every 10 years, with an average of 4 fatalities (statistical analysis based on historicial evidence) • ERTMS, when reliable, would reduce this to 1 in 60 years
Implications for capacity	Lose around 1 in 8 train paths	Possible increase of up to 1 in 10 train paths	• level 1 (and TPWS) likely to reduce capacity • level 2 with cab signalling should increase capacity
Possible safety effect if passengers transfer to cars	680 to 720 additional road fatalities over 40 years	150 to 450 fewer road fatalities over 40 years	• EPT accept they overestimated number of extra fatalities . Level 1 likely to cause no more than 2-3 extra per year at current traffic levels (more road deaths partly offset by smaller reduction in rail deaths)
Approximate capital cost	£6,000 million	£3,600 million	• Reflect extent of project risk and high unit costs in the industry • Further EPT work on refining these estimates – downwards; emphasis on Level 2
Implementation by Regulation	Yes	No	• Public want assurance on delivery • But too soon to regulate given range of uncertainties? • National programme with periodic review by HSC?

Annex 5

Recommendations of the Uff/Cullen Enquiry relevant to ERTMS

Recommendation Number	European Train Control System (ETCS)
18	Fitment of ETCS to lines covered by Directive 96/48/EC (TEN lines) and the draft Directive on Conventional lines should be supported by Regulations (para 11.24).
19	Regulations should be in absolute terms and not dependent on reasonable practicability (para 11.24).
20	HSE should establish a programme for consultation and drawing up of Regulations for the fitment of ETCS with the objective of Regulations being in force within three years (para 11.24).
21	The requirements and objectives to be achieved by Regulations in relation to major lines should be those set out in an Annex 10 of this report (para 11.24).
22	Pilot schemes using ETCS or ETCS elements should be carried out. These should include the following three Recommendations to the extent they are feasible (para 11.27).
23	Fitment of ETCS Levels 1 or 2 should be considered between Aynho Junction and Birmingham Snow Hill (para 11.27).
24	Fitment of ETCS train-borne equipment should be considered on Thames Trains using Great Western Lines, together with an STM to allow use to be made of BR-ATP track equipment (para 11.8, 11.27).
25	The selective fitment of GSM-R radio in advance of ETCS fitment to trains should be considered. For this purpose lines should be identified for the early fitment of ground and track equipment, to be followed by train-borne equipment (para 11.27).
	ETCS Fitment
26	A System Authority should be established to oversee and direct the timely fitment of ETCS, including the current programme for the Old Dalby test track (see Annex 10(m)), (para 11.22).
27	For the purpose of avoiding delays, fitment of ETCS should be independently monitored with reports being submitted at intervals of not more than 6 months, stating whether fitment of ETCS has been delayed or impeded by work on TPWS fitment (para 11.11).
28	All new rolling stock should be compatible with ETCS and GSM-R fitment (Davies Recommendation 11).

Annex 10 of The Joint Inquiry into Train Protection Systems

Requirements and Objectives of Regulations

for Fitment of ETCS to Major Rail Lines

(a)	A requirement that trackside ETCS on the WCML is completed according to the current timetable;
(b)	A requirement that trackside ETCS on the ECML is completed by 2005 or 2006;
(c)	A requirement that full ATP protection is provided on the GWML by 2006 with the possibility of requiring a reverse STM for the FGW fleet;
(d)	A requirement that all lines that carry trains above 100mph are fitted with ETCS by a date not later than 2008;
(e)	A requirement that routes with a line speed between 75mph and 100mph are risk assessed within a specified time to establish the order in which ETCS should be fitted to them.
(f)	A power vested in the HSE or Secretary of state to require that lines falling with (e) are fitted with ETCS;
(g)	A requirement that routes with a line speed of between 60mph and 75mph are risk assessed to enable a decision to be made as to whether ETCS is justified on safety grounds;
(h)	A power vested in the HSE or Secretary of State to require that lines falling within (g) are fitted with ETCS;
(i)	A requirement that all new trains are fitted with ETCS to whatever extent is possible at the time they are built;
(j)	A requirement that the current fleet is retrofitted with ETCS according to a realistic timetable, taking account of the speed of the trains, and where they operate;
(k)	A prohibition against running a non-ETCS fitted train over an ETCS fitted line after 2010, unless TPWS provides equivalent protection;
(l)	A prohibition against running any train over 100mph after 2010, unless it is protected by ETCS or other full protection.
(m)	A requirement to establish a System Authority with powers to manage the installation of track and train equipment.
(n)	A power to grant exemptions and amendments

Annex 6

Summary of EPT "Final Report"
published by SRA and Railway Safety April 2002 – separate document

Annex 7

Technical Report – separate document

Annex 8

Economic Report - separate document

Annex 9

Public Attitude Report – separate document

Annex 10

Summary of written and email responses to the HSE web page on ATP views

89 responses have been analysed to 19 December.
35 came from people who said they worked in the rail industry.

Q1. Should there be regulations for implementation of ERTMS in GB?

45 respondents (out of 89) said that UK regulations were necessary to implement ERTMS in GB. Of these 22 work in the rail industry. Reasons from those strongly in favour were:

- rail companies will only spend money when they have to;
- relying on self-regulatory industry is a myth of post-privatisation;
- since privatisation of the network, there needs to be regulatory pressure – otherwise train operators will delay the work and expenditure;
- must fall in line with Europe;
- a uniform standard should be set throughout the UK;
- because this cannot be left to the discretion of the individual train companies or to those responsible for the rail infrastructure;
- rail industry has not proved itself capable of safe self-regulation, nor effective implementation of the safety systems that are readily available;
- even with regulations the current rail authorities will still be behind time. Regulations will create compliance.

Several respondents said that the regulations should be only introduced when the technology is proven to be accurate, safe and deliverable or without causing detrimental effect on train services, for example, by reducing capacity or simply through unreliability. One suggested that regulation should be drawn up to achieve the best overall safety benefit for the UK by taking into account the risk of shifting traffic onto road because of reduced capacity and/or increased costs of rail travel.

33 respondents were against any regulations. Out of these 10 work in the rail industry. The reasons ranged from:

- not till the problem of road danger is tackled;
- ATP is not necessary and will cause fares to go up pushing more people onto roads and causing more injuries;
- money could be better spent on NHS, hospitals, cancer research etc;
- rail industry is already heavily regulated;
- not until the system is proven and available, which is far from being the case;
- HSE should look at factual outcomes, not intrusive and over-prescriptive regulations.

Q2. Should ERTMS be installed where trains run at over 100 mph by 2010 as recommended by Uff/Cullen, or deferred to 2015, as proposed by the railway industry?

47 respondents (out of 89) would like to see the installation of ERTMS to be deferred to 2015 as proposed by the rail industry. Out of these 15 work in the rail industry. The reasons cited were:

- to allow for technology to be proven at both designated test sites and real world live test areas. Best to wait and get the right system than to rush through a system that is still under development;
- the economic, safety and capacity arguments are in favour of 2015;
- small difference in number of deaths when compared with large difference in cost lead to believe that ERTMS should be deferred;
- 2015 is a much more sensible and realistic alternative and might be achievable;
- would make sense to wait till 2015 for the increased capacity this brings;
- there is already over investment in rail safety and the value of this early (2010) investment is doubtful;
- predictions show that to defer to 2015 would cause fewer fatalities in the overall scheme of things, as well as less disruption to the country.

16 respondents (out of these 9 are from rail industry) felt that ERTMS should be installed by 2010. 3 people thought that to delay beyond 2010 would extend the risk to people who use rail services and cause even more accidents and fatalities. 2 people commented that the Uff/Cullen date was too optimistic as it failed to take account of the time needed to develop ERTMS Level 2 into a reliable system. A few respondents were not in favour of ERTMS installations and the reasons included were:

- it is waste of money which could be better spent elsewhere;
- installing ERTMS is a total waste of money and diversion of efforts;
- ERTMS should only be installed if the risk assessment shows that it is justified;
- must have something better;
- the system should not be forced onto the rail industry until it is proven and fit for use;
- better to install a proven system than wait for an advanced one;
- money could be better invested in health care, for example, where more lives could be saved.

One respondent said that no time limit should be imposed as the equipment is not proven. 2 respondents thought that the system should be installed as soon as the technology becomes available.

Q3 As an interim measure until ERTMS is sufficiently developed and installed should existing technology (in particular TPWS) be extended more widely on the rail network?

36 respondents (out of 89) felt that this was the right way forward. Out of these 20 work in the rail industry.
28 respondents gave qualified answers and said that TPWS should only be installed:

- if it is shown to be working effectively;
- where there was economic case;
- where there was a likelihood of SPADs;
- only if benefit was positive – TPWS to rural lines will provide little benefit at significant cost;
- if it has shown to be cost effective in saving lives;
- to those signals identified by risk assessment;
- only if justified by risk assessment;
- if it does not reduce the railway capacity;
- on high-speed lines;
- if it is not an excuse for delaying more effective measures;
- if it does not prejudice the installation of ERTMS; where it offers a reasonable value per fatality;
- where it is justified but not as network-wide system.

The rest of the respondents did not support the interim measures. Some thought that money could be better spent on improving road safety.

Q4 Given the information on the safety benefits of ERTMS, should any decision to fit ERTMS be determined purely by economic factors?

55 respondents (out of 89) did not think that the decision to fit ERTMS should be based purely on economic factors. Out of 55, 20 work in the rail industry. Many thought that the other factors should be taken into consideration and the reasons included:

- cost benefit calculations used for road improvements should be used since rail is safer to start with;
- safety benefits should be assessed including likely effects of reduced track capacity and/or increased passenger costs;
- must strive to fit enhanced safety equipment where it can be demonstrated to bring clear increase in passenger and staff safety;
- safety benefits of ERTMS are marginal – it would be better to spend money on improving crashworthiness of rolling stock or improving roads and the payoffs in terms of lives saved would be greater than ERTMS;
- broader view of safety including road deaths should be considered;
- number of lives that could be saved on the roads for the same cost and safety should be important;

- safety and costs are linked – for arguments sake, if ticket price rose to £1000 per mile for an allegedly100% safer journey, no one would use it but would travel by road instead.

30 respondents agreed that the decision should be determined by economic factors and the reasons cited were that resources needed for ERTMS would save more lives if spent on road safety, the NHS etc, it would be ridiculous to bow down to the "spend any amount of money to save one life" brigade, if funds are limited, it may be more effective to invest in other improvements to rail infrastructure eg better fencing to reduce trespassing or removal of open level crossings.

3 respondents did not answer the question and one did not understand the question.

Q5. We would like to hear your views or related questions on the issues, which you think important. We look forward to hearing from you.

General Comments

The overwhelming majority of the respondents thought that the HSE/Government should be considering the public transport system as a whole rather than rail safety in isolation. They said that the effort should be put in making the roads safer eg. by compulsory speed limits rather than spending billions of pounds on relatively small safety benefits on the railways. To quote a few:

- Spending vast sums of money on railways to eliminate all risk from rail will make the railways more unaffordable to users, and transfer more people to roads which are very much less safe;
- Would like to see safety requirements for staff working on roads to be same as staff working on railway tracks. Much more account should be taken of the considerable loss of life on roads and more should be done to reduce this;
- There appears to be a difficulty with HSE in looking at the effect of safety measures on saving life as a whole rather than a myopic view of the Railway on its own, even if the cost effect of additional measures drives many people onto roads and hence increases their risk of exposure to death or injury;
- When is HSE going to enforce fitting something like ATP to road vehicle? I see far more SPADs on the roads every day than I do on railway lines. May be by forcing all road vehicle drivers to have the same level of training as train drivers would help as well;
- The only way to improve safety levels for the UK as a whole is to consider all transport systems. After all, the safest rail system is one with no trains. Rail already has a much lower level of accident and injury risk than the private car – so the logical approach would be one to encourage development and use of a safe and economical rail service;
- Believe there is a significant risk of pricing people off railways onto the much more dangerous roads, due to the cost of all these safety developments falling upon passenger. Common sense needs to be applied with both proposed and existing safety systems;

- Concerned that HSE appears to unfairly load up the railways with a large expense burdens to save few lives when the money on such safety systems could save much more lives by spending it on the public transport system, thus saving far more lives by attracting people away from their private cars;
- The economic case in this development relating to fatalities and accidents should have been much more developed in terms of the costs of the accidents on both road and rail, with values attributable to each;
- The overall benefits for both rail and road users should be the deciding factors. Fatal accidents on roads cost millions as well;
- HSE should work to publicise just how safe train travel is compared with road travel and educate the media so they can take a more balanced attitude;
- There is high priority on the road safety than rail safety. Greater benefits could be achieved with less money on the roads. 10 people die on roads every day, not to mention all the people seriously injured. Lowering speed limit is not the answer;
- Rail accident would be a major news item as opposed to road accident which is briefly mentioned in the news. 10 people a day die on roads every day and this seems to be accepted – it would seem the railways can afford only 0 per year. This is where the industry should be aiming, certainly but you can only lose from this position. If aim was, pick a number, 5 per year, then the industry could win, draw or lose. But it simply would not be condoned for a system such as rail to target killing 5 of its customers each year. Everyone takes calculated risks in their lives everyday. For a Southall survivor to say she has bought a car shows that this decision making is not always rational
- There is no consistent policy on public transport. Government must realise that there are many other factors which are determining congestion on all transport systems;
- Railways are already extremely safe. Why is HSE not devoting more time to the carnage on our roads?
- Why are a relatively small number of casualties considered so much more important than the huge toll of pedestrian and cyclists on our roads?
- Debate about rail safety is usually too narrow – it must always be expanded to include the safety of alternative forms of transport.

Other comments on ATP/ERTMS/TPWS/AWS/TPWS+

Rail industry workers made the following comments:

- “TPWS is not a failsafe system. As a driver with 22 years experience, I had a category B SPAD with a TPWS fitted loco and signal….. TPWS did not work as signalling system had blown a fuse so no power meant no TPWS protection. AWS is now a 100 years old and a much safer system to back it up/replace it should have been in place years ago under BR. Privatisation has stalled the process and need kick starting now by law”.

- “TPWS is a cheap solution and a partial answer to SPAD prevention. There is a need to emphasise driver route knowledge to get the basic knowledge and experience right before letting them loose in the traffic.”

- “The fitting of ERTMS should not be priced out of proportion as the West Coast upgrade has been by greedy contractors”.

- “ATP should not be regarded as the holy grail- there are many improvements to our network that are more pressing and would be money better spent in the short term”.

Annex 11

Summary of stakeholder discussions

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