

RAILTRACK

*Safety & Standards***SAFETY JUSTIFICATION****ISSUE: I****DOCUMENT INFORMATION**

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PART 1 – SCOPE OF SAFETY JUSTIFICATION

This justification covers the changes to the existing standard. The significant changes are based on analysis which demonstrates that, based on a figure of £10m Vpf (value for preventing a fatality), it is justified to mandate enhanced emergency braking for classes 158, 159 and 442 vehicles. These classes (amongst others) are included in clause 5.4 of GM/RT2044 issue three, which documents exemptions from the requirements. This change therefore includes an amendment to the list of exemptions.

In this particular case, a Vpf of £10m has been used as this is commensurate with the Vpf used for TPWS. The provision and benefits of EEB are integral with those for TPWS. This has been widely consulted with industry and endorsed by Safety Advisory Board (SAB).

In addition, the Railway Group Standard (RGS) file contained unresolved comments from issue three of GM/RT2044 (issued for high speed tilting trains project) and these have been dealt with in the drafting of issue four.

PART 2 – RISKS BEING CONTROLLED

Enhanced emergency braking (EEB) contributes predominantly to the control of the risks of collision or derailment due to a train passing a signal at danger. More specifically it reduces the possibility that a train would reach a conflict point or mitigate the consequences should a collision or points run over occur. It is therefore complementary to TPWS and reduces a proportion of risk which will remain after its implementation.

Incident records also suggest, that emergency brake applications may also have been effective in preventing or mitigating the risk of trains striking objects or persons on the line, and vehicles on level crossings.

PART 3 SUMMARY OF CONTROLS

Railway Group Standard GM/RT2044 defines the performance requirements and principles of operation of the braking systems of Multiple Units. The principal amendment to the standard is that there is now a requirement that disc braked Multiple Units in Classes 158, 159 and 442 are provided with higher braking retardation for a driver initiated emergency brake application. The specific performance requirements for higher braking retardation are documented in the standard.

PART 4 – COSTS AND BENEFITS

The costs and benefits have been assessed by a sub-group of the Railway Industry Standards Strategy Committee (RISSC), which included representation from S&SD and the ROSCOs.

Class 158/159 vehicles are the main focus of the costs and benefits discussed below, because their residual operating life and their annual mileage indicated that they would be the best candidate for the fitment of enhanced emergency braking. It is judged that the conclusions reached for these vehicles also apply to class 442 types while the analysis demonstrated that there is no case for retrofitting class 313 vehicles.

Costs

The estimation of costs has been derived from a detailed analysis of the major tasks involved in the retrofitting of class 158/159 vehicles (Ref. 1). These costs have been verified in consultation with the ROSCOs. Further working of the costs has led to the agreed position provided in Ref. 2.

To summarise the position, the net present value of the costs of retrofitting class 158/159 vehicles with EEB is estimated to be in the range £5m - £9m, with a best estimate value of £6.3m.

Risk Reduction

The risk reduction benefits which would derive from the retrofitting of EEB to class 158/159 vehicles have been estimated on the basis of a detailed 'what-if' analysis of the fatal train accidents between 1980 and 1997, reported in Ref. 3. The assessment took account of alternative control measures, particularly TPWS, so that double counting would be avoided in the estimate of the risk reduction benefits. An alternative approach (Ref. 4) to estimating the risk reduction benefits has been undertaken, based on a larger number of accidents including non-fatal ones, the results of which are consistent with Ref. 3.

Based on these analyses, the number of equivalent fatalities which would be averted by the retrofitting of EEB to class 158/159 vehicles is estimated to be 0.041 per year.

Financial value of risk reduction

The Value of Preventing a Fatality (Vpf) used to translate risk reduction benefits into financial values, is specified in Railtrack's Railway Safety Case and updated annually in the Railway Group Safety Plan. The Vpf for the financial year 2000/2001 is £1.15m, which is scaled up to £3.22m for either multi-fatality risks, or where the level of individual risk is close to the unacceptable region of the ALARP spectrum.

In the case of the fitment of TPWS neither of the standard values were used. The anticipated risk reduction requires a value of approximately £10m to match the investment associated with its fitment. An increased benefit for TPWS is achieved by provision of EEB. It is therefore appropriate that an equivalent Vpf is used to value the benefits of EEB.

Using a Vpf of £10m, and assuming a mean residual operating life of 17 years for 158/159 vehicles, gives a financial benefit associated with the risk reduction due to EEB of approximately £5.2m.

The best estimate value of the ratio of the benefits to costs is therefore approximately 0.84. The sensitivity to uncertainty in the costs, and even more so in the estimated benefits, indicates that the probable benefit to cost ratio lies in the range 0.5 – 1.2.

Discussion

The ratio of benefit to cost for the fitment of EEB to class 158/159 vehicles is estimated to be 0.83, with the uncertainties indicating that the actual value would be in the range 0.5 – 1.2.

Given the proximity of the estimated value to unity, and the range of uncertainty estimated, it is concluded that the fitment of EEB to class 158/159 vehicles should proceed. The Vpf of £10m which underpins this conclusion is higher than the standard values specified in the Railway Group Safety Plan, but is consistent with the value associated with the anticipated risk reduction benefits which will derive from TPWS. Since the nature of the risks which are predominantly addressed by EEB and TPWS are broadly the same, it is appropriate that a common value should be used.

The major focus of the assessment of costs and benefits has been on class 158/159 vehicles because their high mileage and prospective operating life meant that is where the majority of safety benefit would reside. However a less detailed analysis (Ref. 3) indicates that the benefit to cost ratio for class 442 vehicles would be approximately the same as for class 158/159 vehicles, but a much smaller ratio is estimated for class 313s. It is therefore concluded that the EEB modification should proceed for class 442s but not for class 313s.

PART 5- CONCLUSIONS

Railway Group Standard GM/RT2044 has been amended, the main impact of which has been to require the retro-fitment of enhanced emergency braking to Class 158, 159 and 442 Multiple Units. The provision of EEB contributes predominantly to the control of collisions and derailments following a SPAD, and in doing so enhances the effectiveness of TPWS. An analysis has shown that the financial value of the risk reduction due to the specified requirement for EEB approximates the cost of implementation when a Vpf of £10m is used. This value corresponds to that which derives from the implementation costs of TPWS. On this basis it is concluded that the requirement to extend the fitment of EEB in GM/RT2044 is justified.

- Ref 1: Class 158 Enhanced Emergency Brak Independent Cost Assessment
WS Atkins report no. BK5508/001, 1 February 2000
- Ref 2: Final cost breakdown for retrofitment of EEB to class 158/159 vehicles.
Memo dated 28/03/2000 – A J Kirwan to Richard Neil (ATC), Tim Stubbs (Porterbrook), David Jordan (WSA)
- Ref 3: Retrofitment of EEB – Cost Benefit analysis for classes 158, 313 and 442.
Sedgwick Wharf report, 14 January 1999 – S&SD file ref. GM/RT2044.
- Ref 4: Peer review and summary of costs and benefits for retrofitment of EEB to class 158/159 vehicles.
S&SD report RT2044/CBA/Review/1 – August 1999.