



# Overview of the issue 4 Risk Profile Bulletin

## Introduction

The assessment and understanding of risk are the first key steps in managing safety effectively. Our understanding of safety risk should not be based just on perception, but on past evidence and data, and the best information on potential future risk that can be derived from them. A complete audit trail from data to decision making is essential.

The Safety Risk Model (SRM) is a vital tool in providing this risk insight. It provides a structured representation of the causes and consequences of potential accidents arising from railway operations and maintenance on the mainline railway. The SRM models 120 hazardous events that could lead directly to injury or fatality to passengers, workers or members of the public (MOPs). These events include hazardous event train accidents (HETs), movement accidents (HEMs) and non-movement accidents (HENs).

The Risk Profile Bulletin (RPB) provides risk information to assist members of the Railway Group to manage safety effectively, and to inform the Railway Group and the wider railway industry of RSSB's current view of the dominant contributors to risk on the mainline railway. The risk information contained in this document relates to the system-wide risk on the mainline railway covering all running lines, rolling stock types, locations and stations currently in use.

The risk results are presented as a measure of the absolute risk and should only be used as an input to, and not as a substitute for, decision-making. The emerging thinking on safety decision-making within the railway industry has recognised the need to consider the distribution of risk in terms of fatalities, major and minor injuries, as well as equivalent fatalities. Therefore the RPB issue 4 has been developed to support this, and all risk figures are presented in terms of equivalent fatalities, fatalities, major and minor injuries per year.

## Overall risk profile

Table 1 below shows the total risk broken down by accident category and injury type.

Accident category	SRM version 4				
	Eq. fats/yr	Fatalities/yr	Major injuries/yr	Minor injuries/yr	Shock/trauma /yr
Train accidents <sup>1</sup>	12.0	9.2	20.5	141	- <sup>2</sup>
Movement accidents <sup>1</sup> (excl. trespass)	35.4	15.7	76.4	2,285	131
Non-movement accidents <sup>1</sup> (excl. trespass)	93.3	8.4	347.9	8,848	1,179
Trespass <sup>3</sup>	50.4	47.6	23.9	25	50
<b>Total</b>	<b>191.1</b>	<b>80.9</b>	<b>468.7</b>	<b>11,299</b>	<b>1,360</b>

**Table 1: Total risk by accident category (excluding suicides)**

When compared to the results from version 3 of the SRM, there have been risk reductions in 3 out of the 4 accident categories. The average risk to passengers, staff and members of the public from the 120 hazardous

<sup>1</sup> For some types of level crossings it is difficult to distinguish between events relating to road vehicle occupants and pedestrians injured while using the crossing legitimately and those who are injured while trespassing on the crossing when it is closed to the road users. These risk estimates therefore include all road vehicle occupant, pedestrian, and trespasser events at level crossings.

<sup>2</sup> For the purpose of train accident analysis, shock and trauma injuries have been included in the minor injuries category as it is not possible to extract the proportion of injuries that are shock and trauma.

<sup>3</sup> Excludes road vehicle occupants, pedestrian and trespassers incidents at level crossings.

events, excluding suicides, is predicted to be 191.1 equivalent fatalities per year (81 fatalities per year, 469 major injuries per year, 11,299 minor injuries per year and 1,360 shock/trauma events per year (assumed to be weighted the same as minor injuries)).

The key factors that cause the differences in the predicted levels of risk between the SRM version 3 and version 4 are as follows:

#### **Train accidents:**

- Update of the data used as the basis of the analysis that gives a genuine reduction in the number of predicted train-to-train collisions per year, buffer stop collisions per year and derailments per year (most notably in the area of freight train derailments on passenger lines).
- Some risk reduction from the early stages of the Mark 1 rolling stock removal to the end of 2003.
- Improvements in the modelling of wrongside signalling failures and signaller errors.
- Expansion of the SRM to include the risk from train divisions, runaways and category D SPADs.

#### **Movement and non-movement accidents:**

- Update of the data used as the basis for the analysis.
- Reduction in the overall level of vandalism particularly in the area of objects thrown through train windows.
- Some risk reduction from the early stages of the Mark 1 rolling stock removal to the end of 2003.
- Refinement of the analysis within the SRM for the cases where there is little or no data on which to base the models.
- Increased levels of reporting and improved data analysis.
- An increase in the number of workforce minor injuries

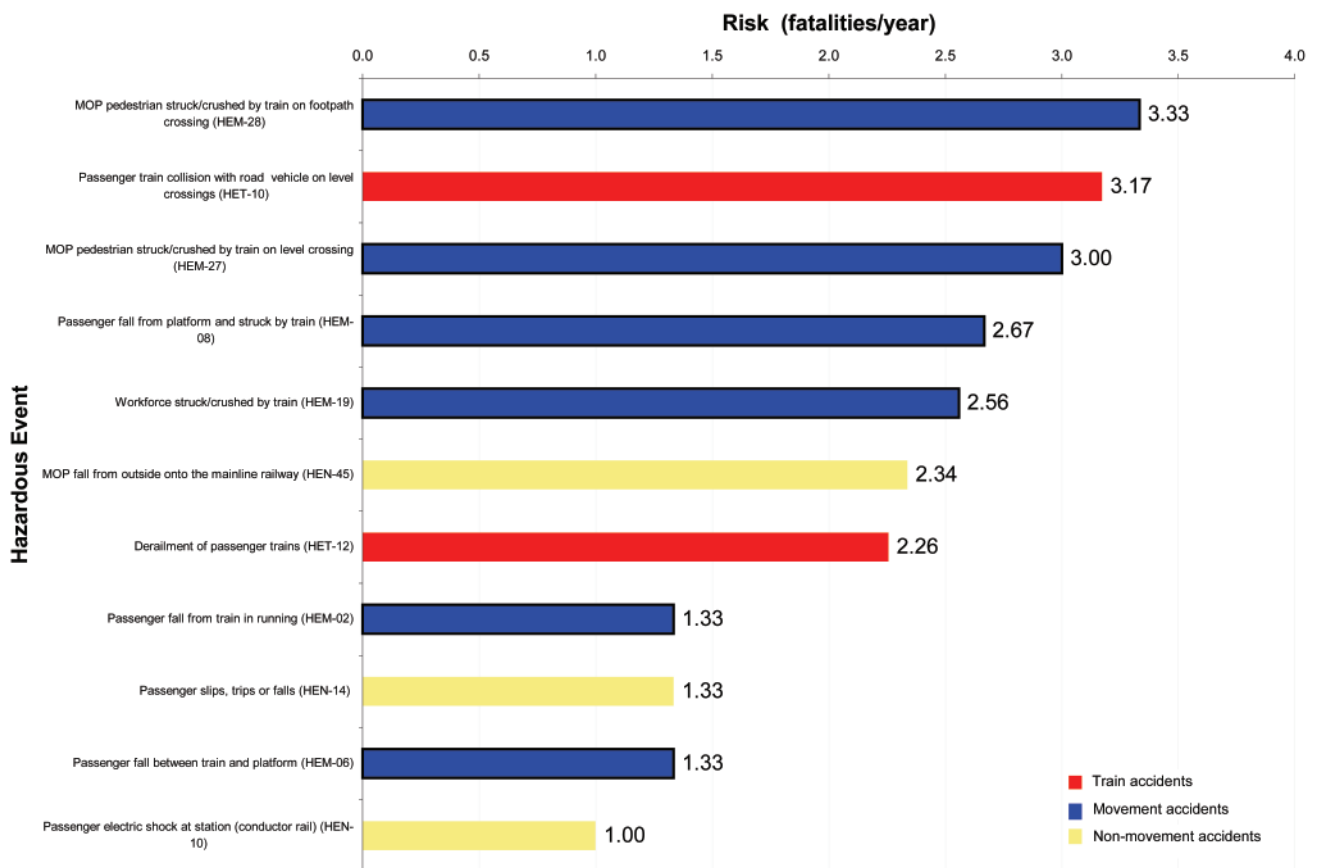
#### **Trespass:**

- Update of the data used as the basis for the analysis.
- Significant reduction in the number of incidents of fatalities due to trespass over the period 2001 to 2003 as a result of the attention to hot spots, new and better maintained fencing and improved education programmes.

### **Detailed risk profiles**

When considering the hazardous events that contribute most to risk, in terms of equivalent fatalities per year, HEM-25 *adult trespasser struck/crushed while on the mainline railway*, provides by far the greatest risk contribution at 32.95 equivalent fatalities per year, representing 8.51% of the overall risk on the mainline railway. The highest train accident related hazardous event is HET-10, *passenger train collision with road vehicle on level crossing*, at 3.73 equivalent fatalities per year, representing 0.96% of the overall risk on the mainline railway. HET-01, *collision between two passenger trains (other than at platform)* is the 40<sup>th</sup> most significant hazardous event with a risk contribution of 0.69 equivalent fatalities, representing 0.18% of the overall risk on the mainline railway.

When considering the risk contribution in terms of fatalities only, the profile changes significantly. The risk profile showing all the hazardous events (excluding trespass and suicides) that have a risk contribution of greater than one fatality per year is shown in Figure 1. It can be seen that the greatest contribution comes from HEM-28: *MOP pedestrian struck/crushed by train on footpath crossing*, at 3.33 fatalities per year. The highest train accident related hazardous event is again HET-10, *passenger train collision with road vehicle on level crossing*, at 3.17 fatalities per year.



**Figure 1: Risk profile for all accidents with the potential for >1 fatality per year (excluding trespass and suicide)**

Risk profiles for train, movement and non-movement hazardous events, as well as detailed precursor risk profiles in terms of equivalent fatalities, fatalities, major injuries and minor injuries can be found in the RPB.

### Individual risk

In the HSE's decision-making process document, 'Reducing Risks, protecting people' (R2P2), criteria are given for the individual passenger risk (commuter), individual employee risk (any group of staff) as shown on Figure 2. The range between the upper limit of tolerability and broadly acceptable represents the range over which risk must be demonstrated as being as low as reasonable practicable (ALARP).

### Passenger individual risk

For a typical train operating company it is the regular travellers (commuters) who are normally considered to be the most exposed passenger group. It has been assumed that a regular traveller on average makes 450 journeys per year (2 journeys per day, 5 days per week for 45 weeks per year) and the typical number of passenger journeys per year is 1001,000,000. Based on these figures, the average passenger individual risk (probability of a fatality per year) is approximately 1 in 159,236 per year. Comparing results to version 3 of the SRM, the overall level of passenger individual risk has reduced by 18%.

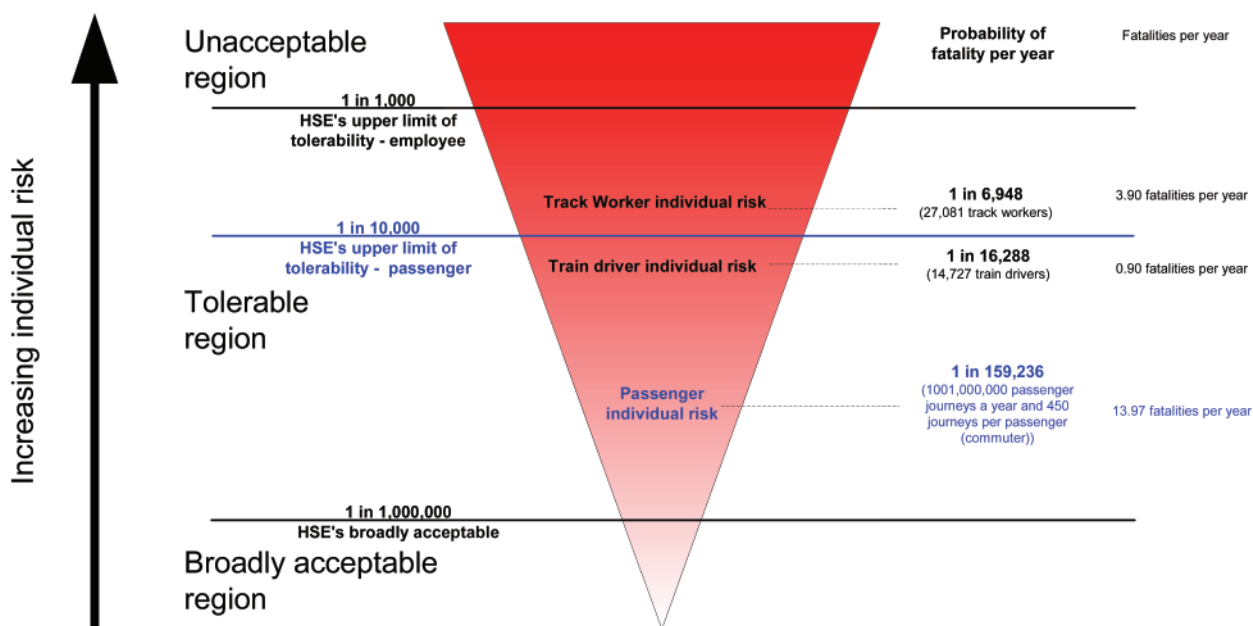
## Train driver individual risk

The total number of train drivers currently employed on the network is 14,727 made up of 11,580 passenger train drivers and 3,147 freight train drivers. Based on this population of drivers it has been estimated using the SRM v4 that the average individual train driver risk is 1 in 16,288 per year, with TPWS. This is a 20% decrease when compared to the SRM version 3 results.

## Track workers

The total number of full time equivalent track workers estimated to work on the network is estimated to be 27,000 with the average individual track worker risk estimated as 1 in 6,948 per year. Comparing results to version 3 of the SRM, the overall level of track worker individual risk has increased by 1%.

All the above individual risk estimates for passengers, train drivers and track workers are shown on Figure 2, alongside HSE's tolerability criteria for passenger (commuter) and employee individual risk. It can be seen that in terms of individual risk exposure, track workers are exposed to the highest level of individual risk than any other worker on the railway.



**Figure 2: Individual risk estimates for passengers, train drivers and track workers**

The RPB contains detailed discussion on the individual risk estimates for passenger, train drivers and track workers.

Also analysed within the RPB are multiple fatality risk, level crossing risk and the estimated risk reduction from the removal of Mark 1 rolling stock. Grouped precursor risk contributions eg track faults, vandalism, are also provided. Finally, you will find a detailed description of the Safety Risk Model, its modelling approach and assumptions as well as information on safety decision-making and current research and development projects related to the SRM.

The RPB will be distributed on CD-ROM to stakeholders in January 2005, followed by an industry briefing scheduled for February 2005.

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