



# Overview of the Risk Profile Bulletin, issue five

## Introduction

To manage safety effectively, it is vital that we are able to assess and understand the safety risk associated with our railway. The Safety Risk Model (SRM) is the core source of information for the rail industry in this area. It is a structured representation of the 125 hazardous events that could lead directly to injury, or fatality, during the operation and maintenance of the GB mainline railway. The SRM considers the system as a whole, rather than the details for a particular route or operator.

The SRM is, where possible, populated using relevant historical accident data. It also includes predictions of the risk contribution from low frequency but potentially high consequence accidents for which there is little or no relevant data available. Where little data exist, the model makes use of structured expert judgement from technical specialists and statistical methods. In this way the SRM provides an estimation of the *underlying* levels of risk on the railway that is not obtainable from historical data alone.

The Risk Profile Bulletin (RPB) is a significant output from the SRM. It provides comprehensive information on the frequency, consequence and risk associated with each of the 125 hazardous events and their causes. This enables identification of the dominant railway risk contributors and evaluation of the safety benefits associated with safety improvements such as TPWS+ and the removal of Mark 1 rolling stock. This information and other analyses in the RPB assist the railway industry (and other interested parties) in developing and managing safety strategies. The RPB covers all running lines, rolling stock types, locations and stations currently in use on Network Rail Controlled Infrastructure.

Issue 5 of the RPB updates the information included in Issue 4 (published in January 2005) and is based on Version 5 of the SRM. The most significant changes involve:

- An update of the data used as the basis of the analysis to the end of December 2005.
- Removal of Mark 1 rolling stock from the network.
- The addition of TPWS +.
- Integration of the on-track plant (OTP) hazardous events (previously contained in the OTP SRM).
- Improvements in the modelling of movement<sup>1</sup> and non-movement<sup>2</sup> accident consequences.
- The addition of five new hazardous events, including the risk associated with the use of *assisting trains* and *manual handling*.
- Classification of level crossing incidents as *proper use* and *misuse*, rather than *trespass*.

## Overall risk profile

When compared to the SRM version 4 results, there has been a continued reduction in the risk from train accidents, movement accidents, trespass and OTP. For the first time there is a slight increase in the risk from non-movement accidents. Figure 1 shows the total risk, broken down by accident category and injury type, presented in fatalities and weighted injuries per year (FWI/year)<sup>3</sup>.

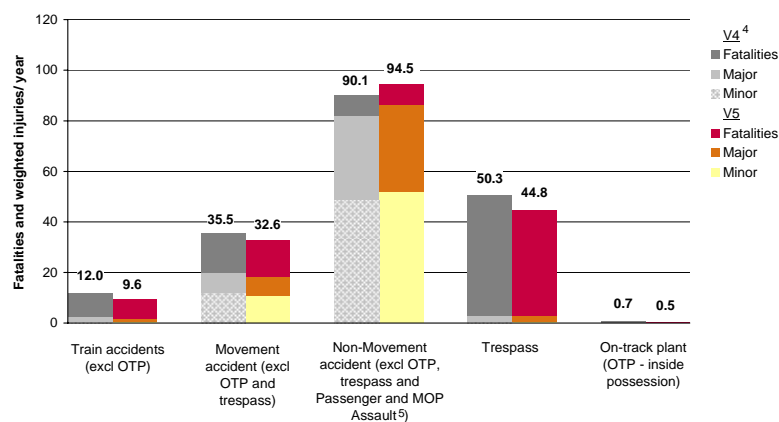


Figure 1: Total risk by accident category (excluding suicides, and passenger and MOP assault)

The overall risk, from v4 to v5, has reduced from 188.6 FWI/year to 182.0 FWI/ year.

Notes can be found on the final page.

The key factors that have caused the differences in the predicted levels of risk between versions 4 and 5 of the SRM are as follows:

*Train accidents:*

The 20% reduction in train accident risk (from 12.0 FWI/ year to 9.6 FWI/ year) is derived from:

- An actual reduction in the number of predicted: freight train derailments; collisions of trains with objects on line (not resulting in derailment); and SPADs. Modelling refinements also account for some of the reduction.
- Removal of Mark 1 rolling stock, which has reduced total train accident risk by approximately 5%. This is due to the improved post-Mark 1 slam door vehicle crashworthiness and fire properties.

*Movement accidents:*

The 8% reduction in movement accident risk (from 35.5 FWI/ year to 32.6 FWI/ year) is largely due to the replacement of Mark 1 slam door rolling stock with post-Mark 1 rolling stock which has led to:

- Incidents related to passengers falling from Mark 1 slam door stock being essentially eliminated.
- A reduction in the likelihood of passengers falling between the train and platform due to improved stepping characteristics.
- A reduced likelihood of passengers attempting to board or alight from a moving train.

*Non-movement accidents:*

The 5% increase in non-movement accident risk (from 90.1FWI/ year to 94.5 FWI/ year) is due to:

- There being an actual increase in the number of *passenger slips, trips and falls* per year arising from the 7.7% increase in passenger journeys per year.
- The inclusion of two new *manual handling* related hazardous events.

*On-track plant:*

There has been no significant change in the risk, from version 4 to 5, associated with on-track plant.

*Trespass:*

The reduction in trespass risk, from v4 to v5 of the SRM, is largely due to the reclassification of several trespass fatalities as suicides following coroners' verdicts. There is no real significant change in the overall level of risk from trespass between version 4 and 5 of the SRM.

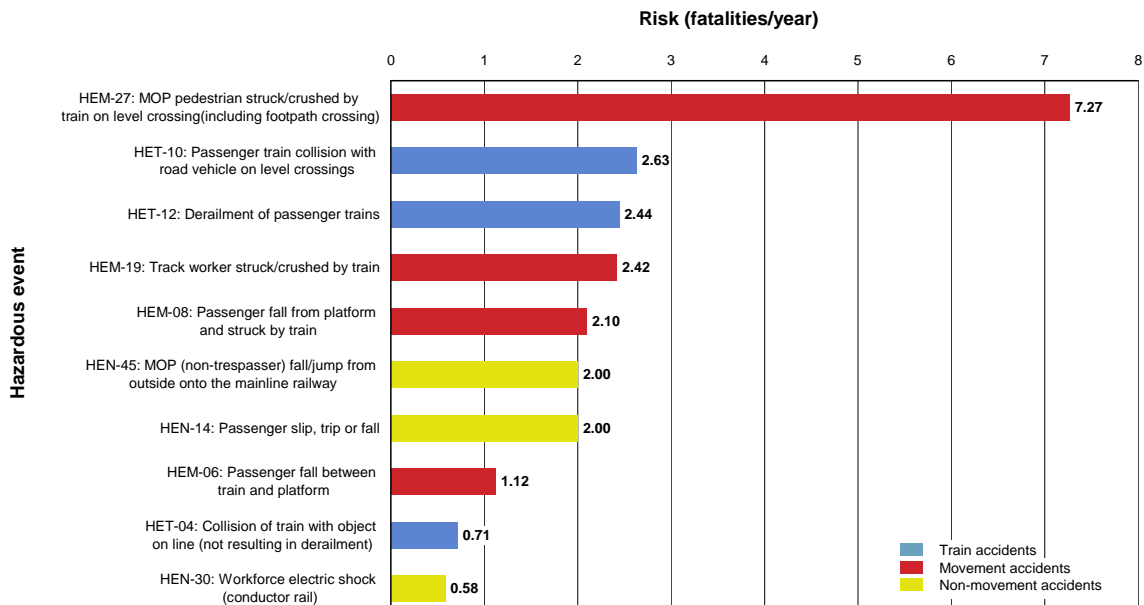
## Detailed risk profile

When considering the individual hazardous events that contribute the most to risk, in terms of fatalities and weighted injuries per year, *HEN-14: Passenger slip, trip, or fall* and *HEM-25: Adult trespasser struck or crushed while on the mainline railway* continue to provide the two greatest risk contributions (at 29.27 and 28.30 FWI/ year respectively). These represent 32% of the overall risk on the mainline railway.

The two highest train accident hazardous events are *HET-12: Derailment of passenger trains* and *HET-10: Passenger train collisions with road vehicles on level crossings*, at 3.13 and 3.03 FWI/ year respectively. These represent 3.4% of the overall risk on the mainline railway. *HET-01: Collision between two passenger trains resulting from a SPAD (other than in stations)* is the 42<sup>nd</sup> most significant event with a risk contribution of 0.53 FWI/ year, representing 0.3% 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 for the top 10 hazardous events<sup>6</sup> with the potential to cause death are shown in Figure 2.

<sup>6</sup>Notes can be found on the final page.

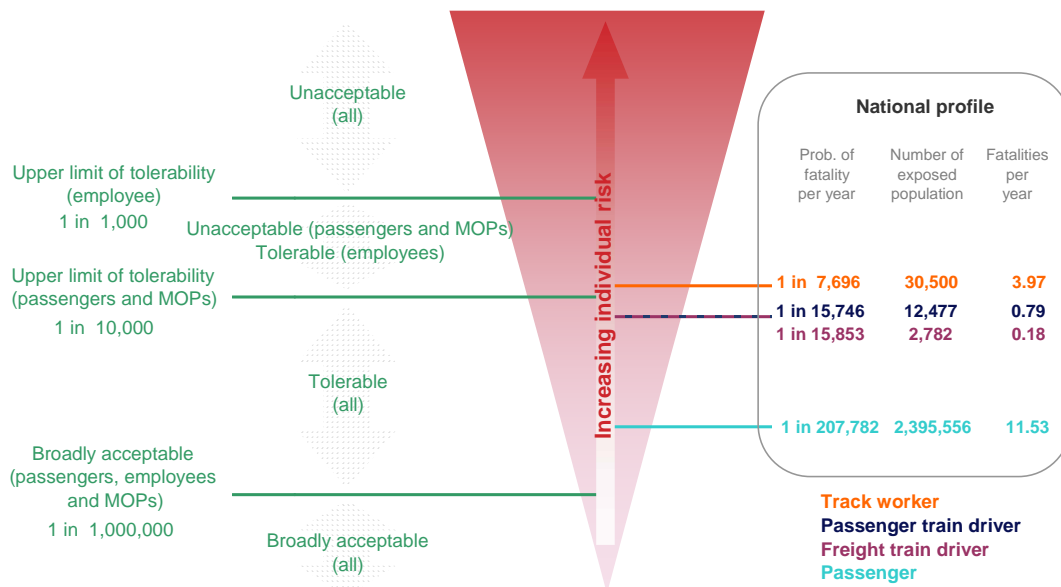


**Figure 2: Risk profile for the top 10 hazardous events (excluding trespass, suicide, and passenger and MOP assault) with the potential to cause death**

It can be seen that the greatest fatality risk contribution comes from *HEM-27: Member of public (MOP) or pedestrian struck or crushed by train on level crossing* at 7.27 fatalities per year. As with FWIs, for fatality risk, *HET-10: Passenger train collisions with road vehicles on level crossings* and *HET-12: Derailment of passenger trains* remain the top two train accident-related hazardous events, contributing 2.63 fatalities per year and 2.44 fatalities per year respectively.

### 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) and individual public risk (railway ‘neighbour’ in R2P2). These are represented in green on the left-hand side of Figure 3, below. The range between the ‘upper limit of tolerability’ and ‘broadly acceptable’ represents the range over which risk must be demonstrated as being ALARP. The national profile for passengers, train drivers and track workers may be found on the right-hand side of Figure 3.



**Figure 3: Individual risk estimates for passengers, train drivers and track workers**

These are estimates of the average individual risk for each exposed group. Some individuals within an exposed group may be exposed to a higher or lower than average level of individual risk depending on, for example, the specific nature of the tasks they carry out. Issue 5 of the RPB shows that the estimated individual risk for a passenger, a passenger train driver and a freight train driver are 1 in 207,782, 1 in

15,746 and 1 in 15,853 respectively. These represent improvements from issue 4 to 5, and may be attributed largely to the removal of Mark 1 rolling stock and the general reduction in train accident risk. The level of track worker individual risk is estimated to be 1 in 7,696. Track workers continue to be the employees with the highest level of individual risk of the exposed groups considered in the RPB. It should be noted that shunters, who tend to carry out their duties in depots and sidings and are therefore out of scope of the SRM, are actually one of the most exposed populations. The four fatalities in the last ten years would suggest that they are likely to have higher individual risk than the four populations discussed here.

### Multi-fatality risk

While there are currently no criteria associated with the acceptability of the frequency of train accidents that could potentially lead to multiple passenger, staff and MOP fatalities, it is important to understand the vulnerability of the railway to such accidents. Table 1, below, shows the results from versions 2 to 5 of the SRM, for the predicted number of years between train accidents that result in greater than or equal to five ( $\geq 5$ ) fatalities, and those that result in greater than or equal to 10 ( $\geq 10$ ) fatalities.

Number of fatalities (passengers, staff and MOPs)	Estimated average number of years between events for each version of the SRM			
	SRM v5 (2006)	SRMv4 (2005)	SRM v3 without TPWS (2003)	SRM v2 (2001)
$\geq 5$	5.3	3.8	2.4	1.4
$\geq 10$	9.1	7.9	5.6	3.1

**Table 1: Years between train accident related incidents leading to multiple fatalities**

It can be seen that since version 2 of the SRM, the predicted frequency of multi-fatality train accidents has reduced considerably. Comparison of the results from version 2 to 5 of the SRM indicate that the average number of years between events resulting in  $\geq 5$  fatalities has increased from 1.4 to 5.3. The average number of years between events resulting in  $\geq 10$  fatalities has increased from 3.1 to 9.1. These major improvements have been derived from: the introduction of TPWS; a significant reduction in the number of SPADs; improved track quality; a significant reduction in the number of non-passenger train derailments; and, most recently, the removal of Mark 1 rolling stock.

### Further information

More detail on the topics discussed above can be found in the RPB issue 5, as well as other analyses such as: grouped precursor risk contributions (eg track faults, vandalism); Mark 1 removal; level crossing risk and TPWS+. A detailed description of the SRM version 5, its modelling approach and assumptions is also provided.

Following the update of the SRM Version 5, the SRM templates for use with Guidance Note GE/GN8561 (Guidance on the Preparation of Risk Assessments within Railway Safety Cases) will also be updated. These will enable all operating and maintenance companies to create a comprehensive risk profile associated with their operations.

The RPB was published in August 2006, and will be followed by the templates in October 2006. Copies will be sent to all industry stakeholders. For further information, please contact the RSSB enquiry desk on 020 7904 7518.

### Notes:

1. These are accidents to people involving trains (in motion or stationary), but excluding injuries sustained in train accidents.
2. These are accidents unconnected with the movement of trains, occurring to people on railway premises.
3. In the Risk Profile Bulletin, the numbers of major and minor injuries are weighted in recognition of their relatively less serious outcome in comparison to a fatality. The current weighting is 0.1 of a fatality for each major injury and 0.005 for each minor injury. The combined measure is designated 'fatalities and weighted injuries' (FWI). The term FWI replaces 'equivalent fatalities', which was used previously within the industry.
4. Version 4 figures recalculated based on the hazardous event definitions and precursor allocations used in version 5.
5. For version 5, BTP data has been used in addition to SMIS data to estimate passenger and MOP assault risk. Analysis from the combined BTP and SMIS data shows that, rather than around 3 FWI per year (as was profiled in version 4 which used SMIS alone), the risk associated with these assaults could actually be in the region of 20 FWI per year. Numbers quoted for passenger and MOP assault should be used only as a broad indication of the likely risk profile. They are therefore not quoted as part of the overall risk figures. RSSB and BTP are working closely together to improve the sharing of information to provide the most accurate risk information.
6. Excluding suicide, trespass, and passenger and MOP assault.