Railway Safety: Analysing Risks and Causes

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Stop all the trains, cut off the signalling

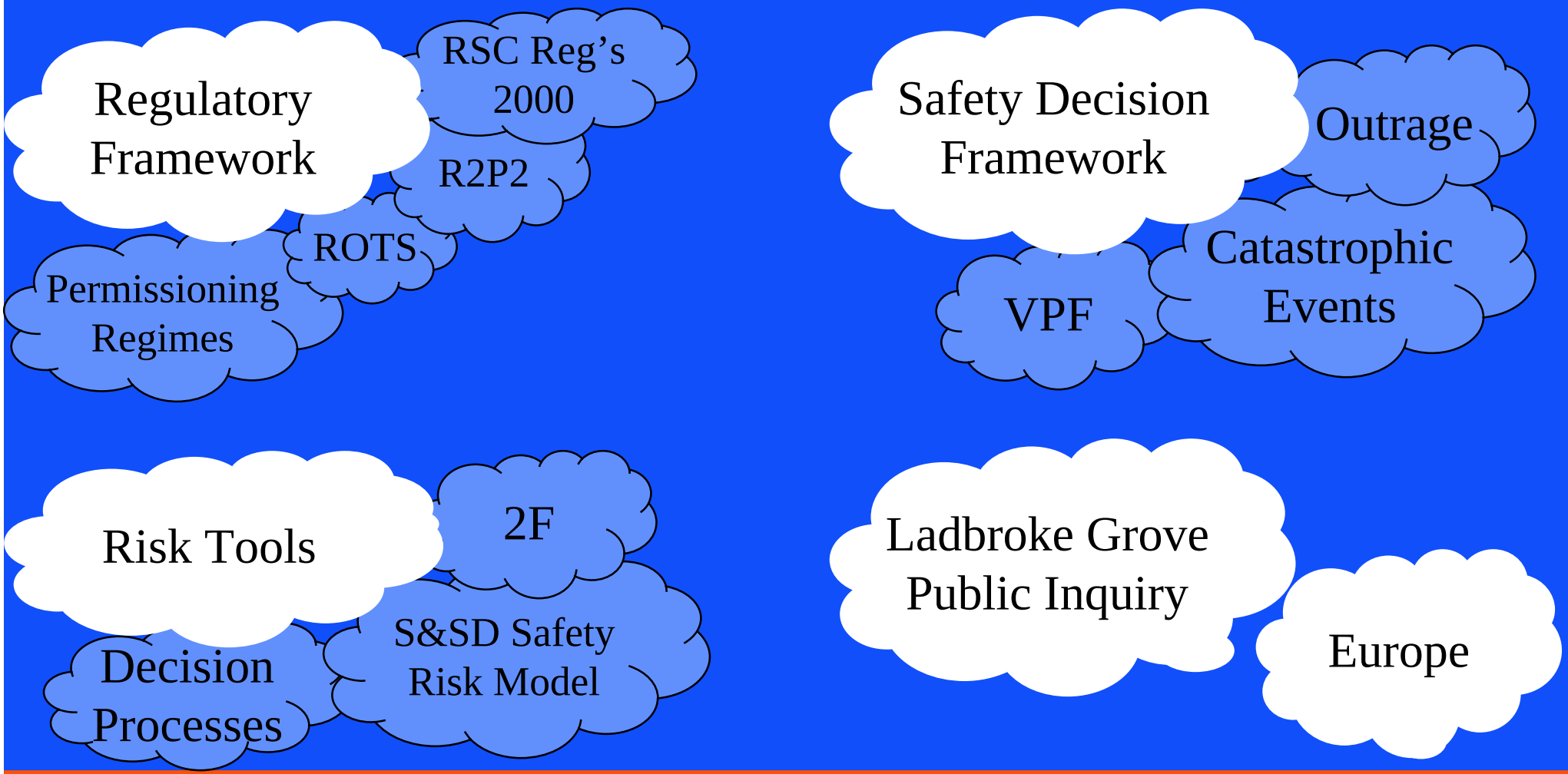
Prevent the TOCs from running with their new plaything

Silence the diesels, all the money is spent

S&SD's found a hazardous event

- with apologies to WH Auden

Agenda


Regulatory Framework
RSC Reg's 2000
R2P2
ROTS
Permissioning Regimes
Safety Decision Framework
Outrage
Catastrophic Events
VPF
Risk Tools
2F
S&SD Safety Risk Model
Decision Processes
Ladbroke Grove Public Inquiry
Europe

Overview

- Role of S&SD
- Railway safety cases
- Safety decision framework
- S&SD's safety risk model
  - Model development
  - Risk profiles
  - Example of model uses

Railtrack S&SD's Safety Roles

- Produce Railway Group Safety Plan
- Establish framework for risk control, incl standards for system safety & safe inter-working
- Manage Railtrack's safety case
- Accept train operators' safety cases
- Audit & assess safety performance of Railway Group members
- Advice and safety leadership

Railway Safety Cases

- Railway's safety case cascade is unique
- Railtrack safety case sets out:
  - *nature of operations on infrastructure*
  - *risks arising*
  - *safety management arrangements*
  - *safety decision framework*
- Railtrack safety case accepted by HMRI
- Train and station operators' safety cases accepted by Railtrack Safety & Standards Directorate (S&SD)

RSC Regulations 2000

- S&SD becomes Railway Safety
- HSE to accept train and station operators safety cases also
- Single process to facilitate involvement by Railtrack, Railway Safety and HSE
- Safety case cascade broken?
- Interfaces?

Railtrack's Safety Decision Framework

- Quantitative tolerability levels set for:
  workers, passengers, public
- In ALARP region, weigh costs and benefits
- Two Values of Preventing a Fatality:
  £1.15m for single fatalities
  £3.22m for multiple fatalities or where risks close to intolerable
- Safety measured in equivalent fatalities:
  1fatality = 10 major injuries = 200 minor injuries

S&SD Safety Risk Model

- System wide risk assessment
- Will underpin Railtrack's safety case
- Structured representation of causes and consequences of potential accidents arising from the operation & maintenance of Railtrack infrastructure
- Exposed populations are:
  - Passengers
  - Workers
  - Members of Public

Safety Risk Model: Scope

- All events that can result in harm to people from the operation and maintenance of the RCI
- Train Accidents (low frequency high consequence) eg:
  - *Collisions*
  - *Derailments*
- Movement Accidents eg:
  - *Passengers falling/injured while boarding/alighting from trains*
  - *train-crew struck/crushed by train*
- Non-movement Accidents eg:
  - *Slips, trips and falls on platforms*
  - *worker trapped in machinery*

Hazardous Events and Precursors

- A Hazardous event is an event which has the potential to lead directly to death or injury, eg collision
- A precursor (cause) is a system or sub system failure, component failure, human error or physical effect, which could individually or in combination with other precursors result in the occurrence of a hazardous event
- Example precursors: broken rail, SPAD, dragging brakes

Identification of hazardous events

- Iterative process using 18 generic injury mechanisms, eg:
  - *Electric shock*
  - *Being crushed*
  - *Falling*
  - *Being hit*
  - *Being trapped*
- Results of this were then checked against:
  - *Previous studies carried out by the industry*
  - *A review process within S&SD*

Identification of hazardous events

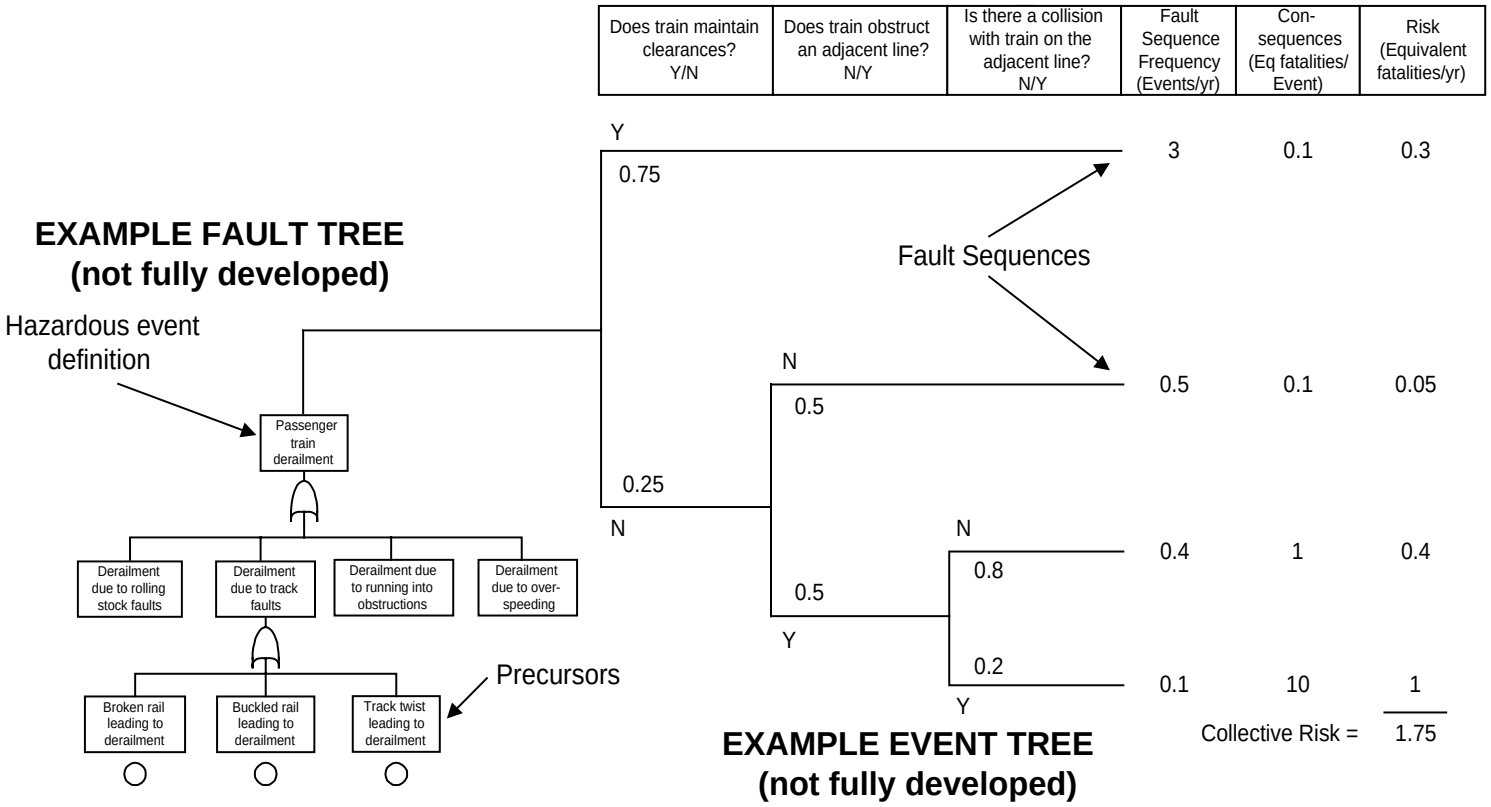
- This iterative process identified 110 hazardous events

- These events were then allocated to either:
  - Train accidents (24)
  - Movement accidents (32)
  - Non-movement accidents (54)

Model Development

- Fault trees of Hazardous Events developed to level supportable by current data sources
- Event Trees for Hazardous Events including:
  - Different types of track & infrastructure features
  - Different times of day
  - Different passenger loadings
  - Other factors which can lead to significantly different outcomes e.g:
    - *Is there a release of toxic or flammable goods?*
    - *Is there a fire?*

Model Example



RELATIONSHIP BETWEEN FAULT TREE AND EVENT TREE ANALYSIS

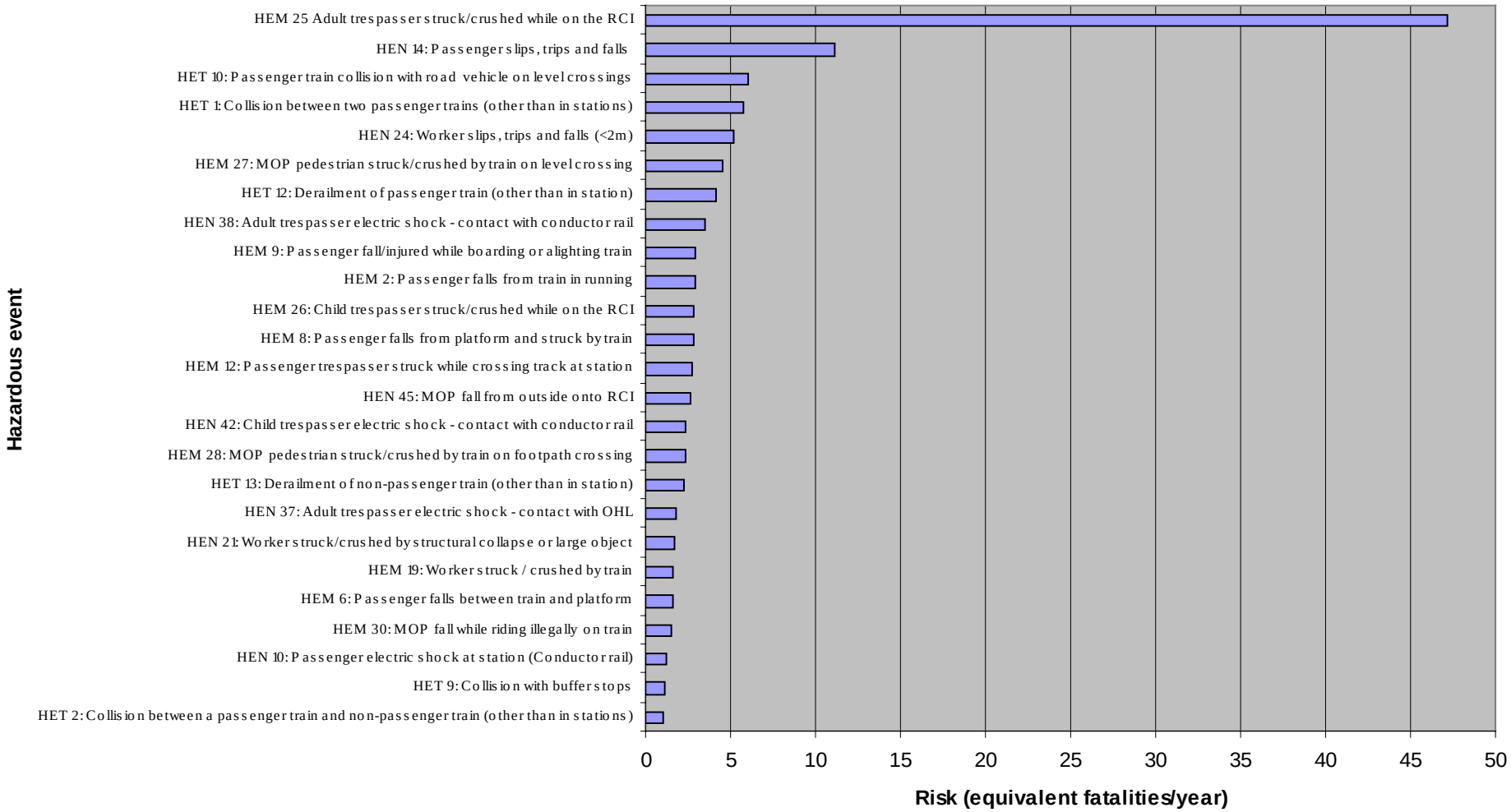
Development of SRM database

- Project Database that contains records on:
  - Fault Tree cause precursor data
  - Event Tree consequence precursor data
  - Event Tree consequence data
- These records contain details:
  - Assumptions
  - Derivations
  - References

Model outputs

- The model produces:
  - The frequency of the hazardous event per year
  - The risk in terms of equivalent fatalities per year
- Using RiskVu™ we are able to analyse the model's results to:
  - Identify the risk profile of the hazardous events
  - The risk contribution from individual precursors
  - The risk contribution from groups of precursors
  - Carry out risk sensitivity to changes in data
  - Produce F-N curves for the hazardous events

Risk profile (equivalent fatalities/year >1)



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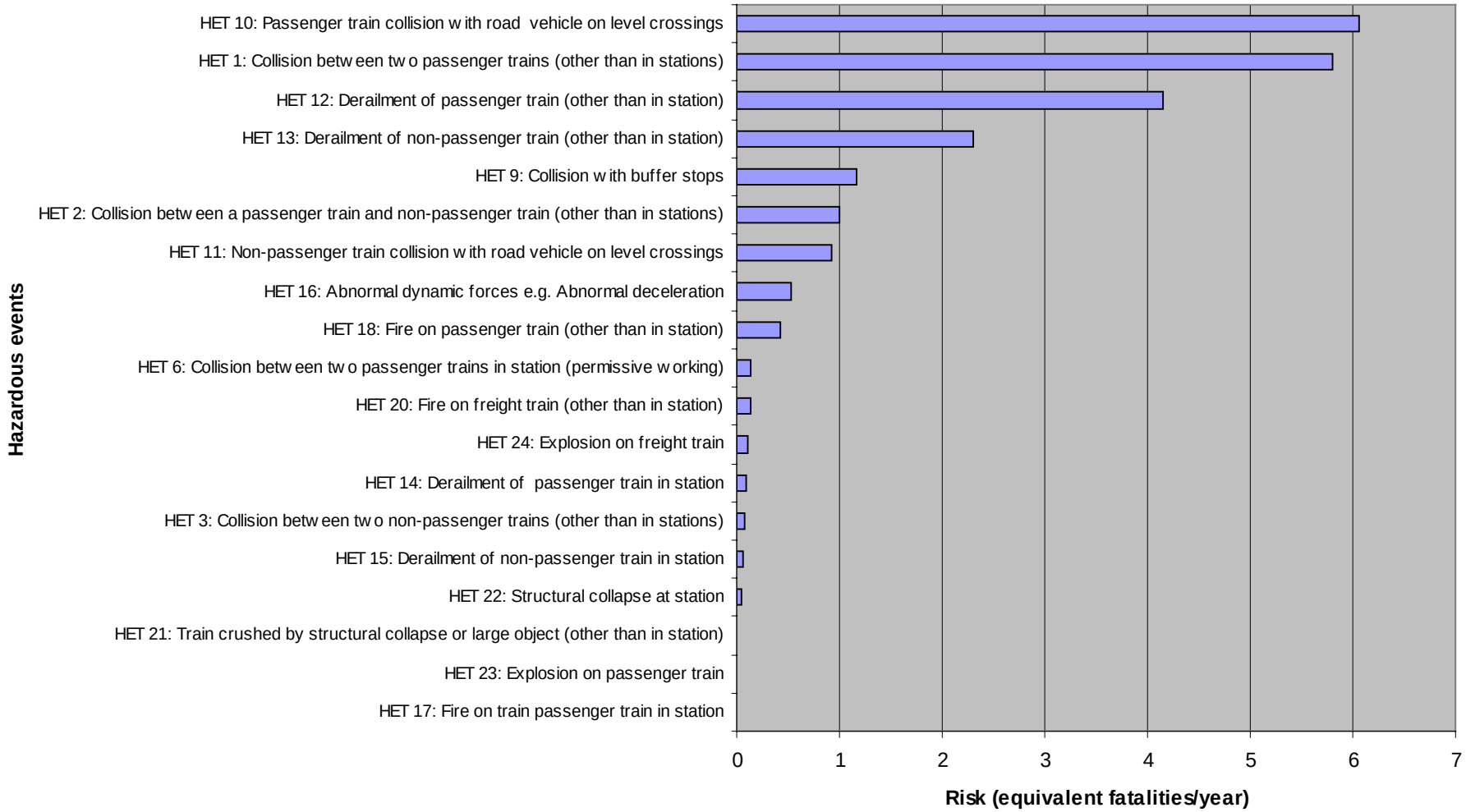
Risk profile: train accidents



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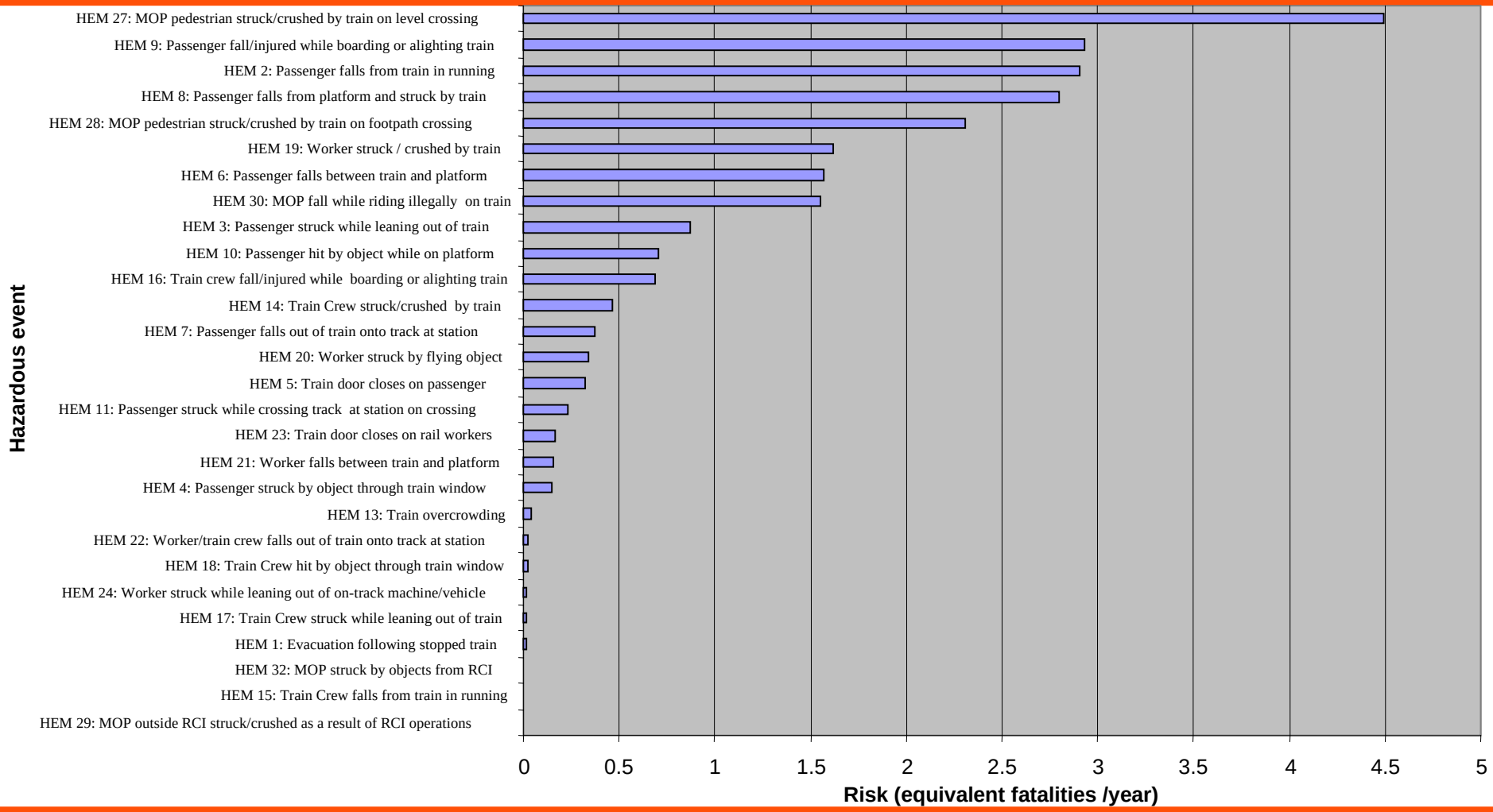
Risk profile: movement accidents



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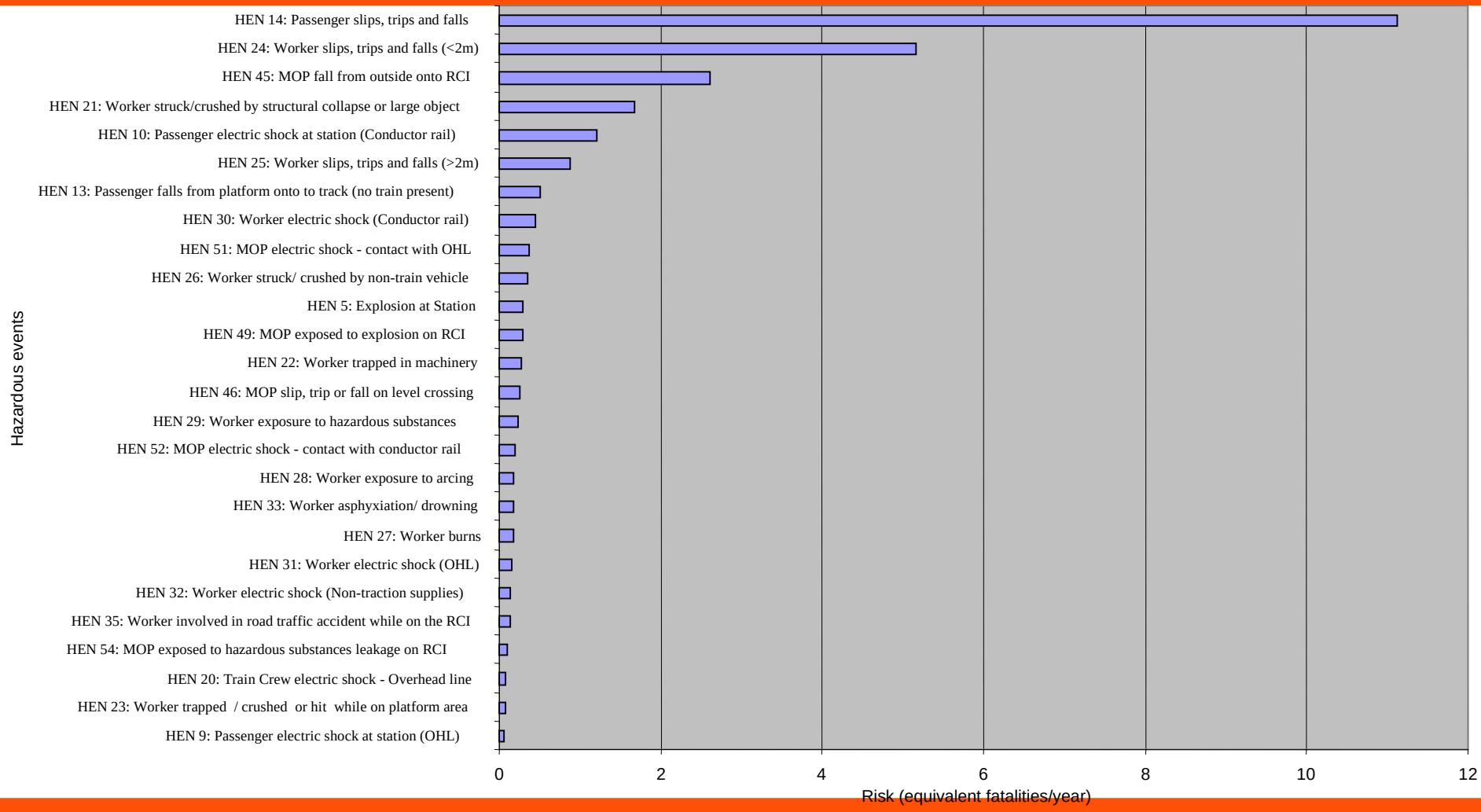
Risk profile: non - movement accidents



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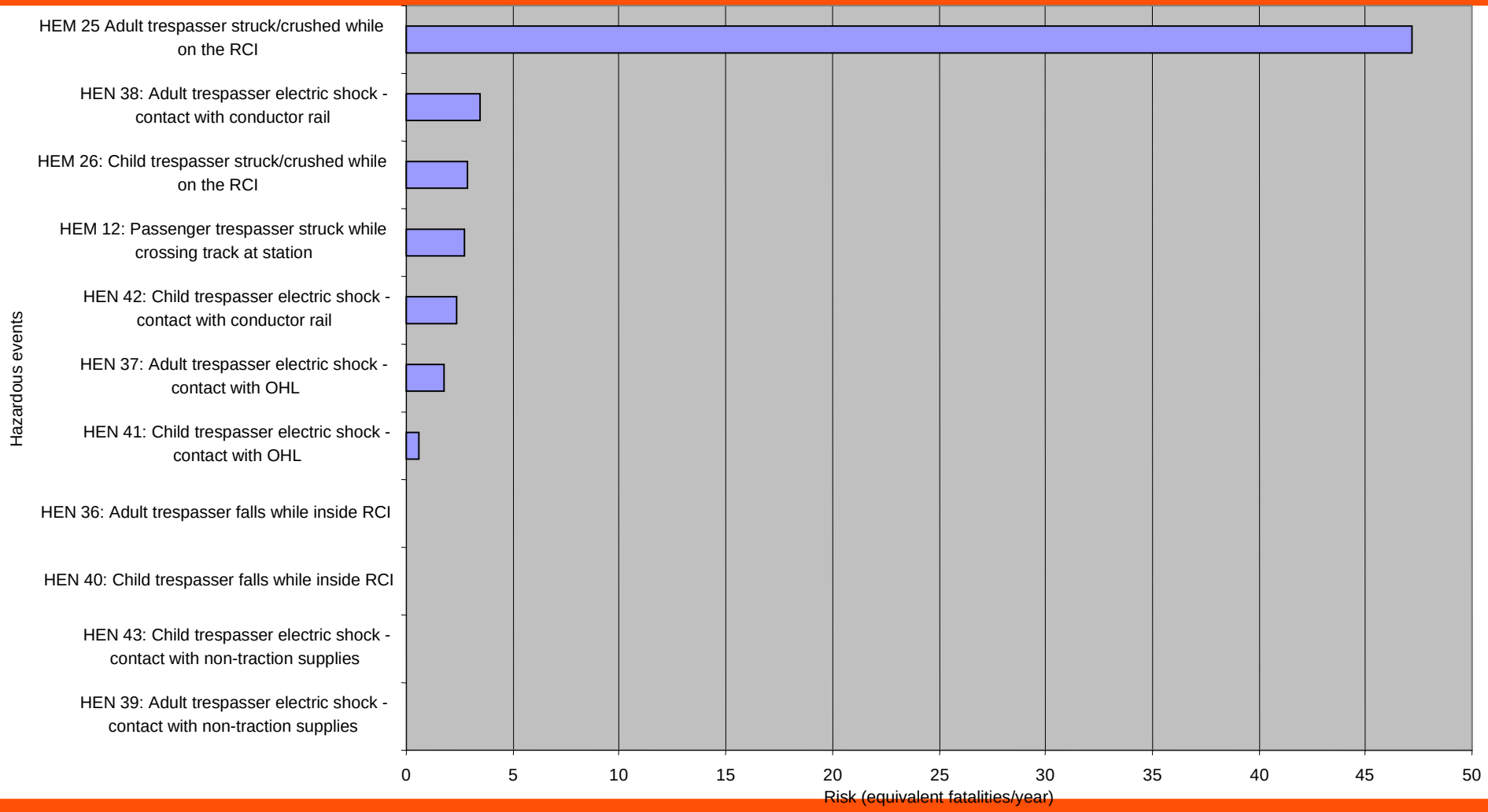
Risk profile: trespass



Example Uses

- The model can be used to respond to questions such as:
  - What is the risk contribution of track twist to passenger train derailment?
  - How much would the overall risk from derailment increase given a 50% increase in the frequency of track twists?
  - What is the current level of risk relating to the operation of road vehicle level crossings?

Where next?

- Risk profile on Railtrack infrastructure
- Risk assessment for Railtrack's safety case
- Available to RG members
- Regular risk profile bulletins
- Identify gaps in risk control, sensitivity analysis, cost benefit assessments
- Inform S&SD activities: Railway Group Safety Plan, Group Standards & audit programme