1. Purpose of paper

1.1 This paper sets out to inform the board and the wider industry about the current level of residual train accident risk, the trends in train accident precursor risk and outline some of the developments that will affect train accident risk in the coming years. The paper is intended to indicate the level of vulnerability of the industry to these types of accident and provide information for the board to consider as potential points for discussion at the strategic risk review scheduled for the January 2013 board meeting.

2. Key trends and issues in train accident risk

2.1 The safety risk model (SRMv7) estimates the risk from train accidents to be 8.4 FWI per annum, which is 5.9% of total risk (excluding suicide). Of this, fatality risk is 6.2 per year, which is around 8.8% of the total industry fatality risk. The highest modelled fatality risk (3.5 fatalities per year) relates to members of the public, mostly in collisions between trains and road vehicles at level crossings. Passengers and workforce make up the remaining at 2.2 and 0.6 fatalities per year respectively. The greatest passenger fatality risk from train accidents arises from train derailments.

2.2 The last train accident that resulted in a passenger fatality was at Grayrigg in 2007. The average number of accidents that resulted in at least one passenger or workforce fatality has reduced from 1.5 per year at the end of 2001/02 to 0.5 per year at the end of 2011/12 (ten year moving average).

2.3 As a measure of the vulnerability of the industry to a significant train accident, it is currently predicted, via SRMv7, that a train accident leading to greater than or equal to 5 fatalities will occur, on average, every 5.8 years.

2.4 The Precursor Indicator Model (PIM) (which indicates the fatality and injury risk to passengers, staff and members of the public from train accidents) shows a 50% reduction in risk over the last 10 years. When only passenger and staff fatalities are considered, an 84% reduction in risk has been achieved over the same period.

2.5 For the year ending June 2012 the PIM indicates that there has been a 6.5% reduction in train accident risk, with notable decreases in the risk occurring from public behaviour at level crossings and SPADs. At the same time, notable increases in the risk have occurred in the areas of infrastructure failures, objects on the line and irregular working.

3. Precursor indicator model (PIM)

3.1 The PIM tracks changes in the risk from the occurrence of the train accident
The precursors and was first developed for the industry in 1999. The PIM is based on the data recorded by duty holders into the SMIS database.

3.2 The precursors covered by the PIM fall into six categories (see Table 1). The current PIM indicator for June 2012 was 88.1\(^1\), this breaks down into 39.6 for passengers, 9.7 for workforce and 38.9 for members of the public (see Appendix C). A snapshot view of some of the ways in which sources of train accident risk are being managed are in Appendix D.

<table>
<thead>
<tr>
<th>PIM group</th>
<th>Ten Years</th>
<th>Last Year</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Infrastructure failures</td>
<td>25.6</td>
<td>14.6</td>
<td>18.4</td>
</tr>
<tr>
<td>2 - Irregular working</td>
<td>22.4</td>
<td>16.6</td>
<td>19.2</td>
</tr>
<tr>
<td>3 - Public behaviour at level crossings</td>
<td>53.6</td>
<td>41.6</td>
<td>34.3</td>
</tr>
<tr>
<td>4 - Objects on the line</td>
<td>13.1</td>
<td>4.4</td>
<td>6.4</td>
</tr>
<tr>
<td>5 – SPAD</td>
<td>51.3</td>
<td>12.5</td>
<td>4.9</td>
</tr>
<tr>
<td>6 - Trains &amp; rolling stock</td>
<td>13.9</td>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>PIM Indicator</td>
<td>179.9</td>
<td>94.2</td>
<td>88.1</td>
</tr>
</tbody>
</table>

Table 1: PIM Indicator groups, comparing ten years ago, last year and this year

4. Infrastructure failures\(^2\)

4.1 Through increased monitoring, maintenance and renewals track failures such as broken rails have reduced by 71% in the last ten years. Conversely the number of structural failures and landslides involving obstruction of the line has been increasing. As a consequence, the PIM indicator for structural failures has increased over the last year.

4.2 The heavy rainfall / flooding during the summer of 2012 resulted in five times the average number of landslips. RAIB is carrying out an investigation into four train accidents caused by landslides during the year.

4.3 Network Rail is working on an improved risk management tool for structures and developing risk assessment for adverse weather (climate change) and landslips. In the longer-term the view is to update asset management policies in CP5. There is also work being undertaken to understand asset degradation profiles through ORBIS.

5. Irregular working\(^3\)

5.1 The PIM indicator for irregular working has increased by 17% in the last year, mainly due to recent high risk ranked events involving workers leaving the track in an unsafe condition and placing objects on unprotected lines.

5.2 Network Rail and RSSB are currently working with train / freight operators to review irregular working for the industry. The aim is to develop a consistent approach to risk ranking irregular working so that industry risk can be properly quantified and responded to. A three month trial is currently underway with three train operators and the outputs to be reviewed towards the end of 2012.

5.3 Human factors research plays an important role in mitigating human error through good practice documents and toolkits to enable companies to manage their own human factors issues. Developments in safety critical

---

\(^1\) The PIM provides an indicator of the trend in train risk resulting from a range of train accident precursors. The PIM values quoted relate to the baseline of 100 set in September 2006.

\(^2\) Infrastructure failures include track, structure, signalling system and level crossing equipment failures

\(^3\) Irregular working looks at events that are people orientated rather than systems orientated. The risk from events such as trains being wrongly routed, objects left foul of the line and level crossings being left unsafe being the more significant. Incidents of irregular working are measured in the PIM based on a risk ranking score.
communications have also played a role in minimising issues with communication.

6. **Public behaviour at level crossings**

6.1 The PIM indicator for public behaviour at level crossings is at an all-time low of 34.3 (ten years ago it was 53.6). Despite two recent road vehicle occupant fatalities at level crossings, there is evidence from the PIM and the trend in the number of collisions between trains and road vehicles at level crossings that the risk at level crossings is reducing. This suggests that the continued effort of the “Don’t Run the Risk” campaigns, the level crossing closure programme and the specific work by Network Rail and BTP on deterrents, enforcement and education is having some effect.

7. **Objects on the line**

7.1 The PIM indicator for objects on the line shows for the second consecutive quarter the indicator has increased. Q1 2012/13 was 39% higher than the previous quarter (which itself was 64% higher than at the end of Q3 2011/12). These rises have been due to a sustained period of trains running into obstructions blown onto the line, resulting from adverse weather.

7.2 Trains striking objects such as large animals are precursors to more serious train accidents such as derailments and are weighted accordingly in the PIM. The most recent example occurred in July this year at Letterston Junction after passenger train struck a number of cows on the line and derailed. A special topic report is being produced by RSSB on this subject.

7.3 Network Rail has been working on several initiatives on the subject including; delivery of national tree management programme based on their standard *Management of Lineside Vegetation*; working with BTP and producing reminders on theft and vandalism; continued delivery of the vehicle incursions management programme to ensure that high risk sites have mitigation measures in place.

8. **Signals passed at danger**

8.1 The number of SPADs has reduced significantly over the ten years from 402 in 2002/03 to 278 in 2011/12. Alongside this has been a 90% reduction in SPAD risk which was at its lowest point at the end of the last financial year. This significant risk reduction in this area has been achieved through some of the initiatives outlined in Appendix A.

8.2 It is noted, however, that over the last six months April to September there has been an increase in risk resulting from an increase in the number of 20+ SPADs, with 10 in the period compared to nine for the whole of 2011/12.

---

4 The PIM indicator for public behaviour at level crossings is based on near misses reported by the train drivers as these are best the precursor measure we have for collisions between trains and road vehicles at level crossings.

5 Objects on the line include more serious precursors to train accidents such as road vehicles through the boundary fences such as Great Heck in 2001 and more recently the accident at Stowmarket in 2011 which is the subject of an RAIB report.

6 The last on-board fatality due to striking an animal occurred travelling at high speed, struck a cow which had wandered onto the track near Polmont Station. Several of the carriages were derailed, resulting in 13 deaths and 61 injuries.
9. **Trains and rolling stock**

9.1 While the contribution of train and rolling stock failures to the overall train accident risk covered by the PIM is small (5.6%), the PIM results in Table 1 above shows a 50% decrease over the last 10 years. The last fatality resulting from a rolling stock defect in Great Britain occurred at Rickerscote in 1996 when a freight train derailed after a wagon axle fractured.

9.3 The reduction in risk in this area has arisen from investment in new rolling stock (passenger and freight), a greater commitment to maintenance and maintenance practices, the use of NIR-Online, staff competence and management including train driving, new technology and departure checks.

10. **Industry cooperation**

10.1 There are currently arrangements in place for industry cooperation to assist in managing train accident risk. Recent initiatives in this area are (a) the modernisation of safety cooperation project and the proposed establishment of a System Safety Review Group, a National Freight Safety Group and Route Safety Groups; and (b) the new High Integrity Software Group. The current arrangements and recent initiatives are described in Appendix B.

11. **Responding to a significant train accident**

11.1 In November 2009 the RSSB board considered the industry’s preparedness in relation to communications following a significant train accident. For most scenarios, it was observed that Network Rail would take the lead role. Since this review there have been changes in senior industry leadership (including changes in membership of the board) and significant structural changes have occurred in the industry. The board may therefore wish to consider again reviewing the industry’s preparedness for responding to such accidents.

12. **Future challenges**

12.1 The years through to the end of CP5 will present the industry with many challenges that could affect train accident risk:

- The drive towards a 24/7 railway
- Growth in passenger numbers and train km
- Climate change
- The need to improve performance while reducing costs (achieving VfM targets) without compromising business (including safety) risk
- Increased use of software based systems
- Organisational change – franchising, devolution, alliancing, etc.

13. **Recommendations**

13.1 The board is invited to:

- **CONFIRM** that they are content that they have reviewed and considered the significant items of train accident risk that impact on the industry.

- **CONSIDER** the points/issues raised in the paper as potential points to be discussed at the strategic risk review scheduled for the Jan 2013 board meeting.

---

7 Within the PIM the precursors for rolling stock failures consider: brakes, axle failures, wheel flats and train fires both due to vandalism and faults. This PIM category also contains failures of safety equipment that require the train to be taken out of service.
Appendix A: Train accident risk – brief history

Over the 10 year period to March 2002 there were 52 passenger and 13 workforce fatalities in train accidents with notable accidents occurring at Southall, Ladbroke Grove, Hatfield and Great Heck. In the 10 years from April 2002 there were 12 passenger and three workforce fatalities with accidents occurring at Potters Bar, Ufton and Grayrigg.

Over this period the rail industry has seen extensive changes, including institutional reorganisation, changes in regulations and significant growth (a 50% increase in passenger journeys and 44% increase in passenger km).

The main drivers behind the reduction in train accident risk has been the application of better technology and improved industry cooperation, such as:

- The Train Protection and Warning System (TPWS).
- Smarter appreciation of operational safety issues, including a broader understanding of the human factors that relate to driver and signaller behaviour in relation to SPADs.
- The withdrawal of Mark I coaching stock from the main line network and replacement with modern more crashworthy rolling stock.
- Improvements in freight rolling stock.
- Industry cooperation through involvement in cross industry groups.
- Improved infrastructure condition monitoring, maintenance and renewal.
- Research and development projects that have sought to reduce the frequency of and/or mitigate the consequences of train accidents. The outputs from the industry research programme led by RSSB on behalf of its stakeholders have included improvements to vehicle design to improve crashworthiness/containment, fuel tanks for survivability, fitment of obstacle deflectors/lifeguards and risk models for maintaining safety levels to as low as reasonably practicable.
Appendix B: Industry Cooperation

Over the years wide varieties of groups, forums and arrangements have been established nationally and regionally to help understand system safety risk, review performance and sponsor improvements. These collective arrangements all play a part in discharging the legal “duty of cooperation” obligation on rail companies.

The cross-industry safety groups that meet regularly to address train accident risk include;

- Operations Focus Group (OFG),
- Safety Policy Group (SPG) and
- Co-operation at the sector level through the OPSRAMs, etc.
- Technical Strategy Leadership Group (TSLG) that develops the Rail Technical Strategy and supports research relating to the future vision for the railway.
- The five separate System Interface Committees (SIC) that often consider issues that can influence the frequency and consequences of train accidents.
- A new High Integrity Software Group reporting to SPG that has been formed to establish and share best practice in the area of high integrity software in railway applications. In general terms, the scope of the group’s considerations is defined as software that is used to operate the railway where safety and/or reliability is important, but excluding systems that are used primarily for commercial purposes.

Following a review of current arrangements by Operation Focus Group (OFG) and Community Safety Steering Group (CSSG); proposals have been developed and consulted to modernise and improve system safety cooperation on the modern railway.

The proposals are based on the application of the “System Safety Lifecycle Model” to form the core of the cooperation process between Safety Management System holders. It has also been proposed that the existing range of national and regional meetings are replaced with:

- A single System Safety Review Group – responsible for reviewing 100% of rail system risk, reviewing performance trends, identifying and sharing good practice and supporting Route and National Groups.
- Dedicated National Safety Groups for freight operators, infrastructure contractors who operate mainline trains, Cross Country Trains and charter train operators.
- Route based Safety Groups between local train operators and their Network Rail route counterparts or equivalent if part of an “alliance”.

RSSB Board Meeting Final: 08 November 2012
Appendix C: PIM and overall safety trends

The Precursor Indicator Model

The PIM measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors. It was first developed in late 1999, and has since been subject to a series of modelling improvements.

Structure

The PIM monitors the risk from train derailments, train fires and train collisions, including those with other trains, buffer stops and road vehicles (both at and not at level crossings). The precursors covered by the PIM fall into six main groups, encompassing 27 separate subgroups and 45 lower level groups.

Figure 1. PIM structure
How the PIM measures changes in train accident risk

The PIM monitors train accident risk to passengers, workforce and members of the public, such as motorists on level crossings. The PIM value is an annual moving average, so it reflects precursors that have occurred during the previous 12 months. It is also normalised by train km, to account for changes in the level of activity on the railway.

The PIM uses the basic equation \( \text{risk} = \text{frequency} \times \text{consequence} \)

Frequency estimates are based on accident precursor data; consequence estimates are derived from the SRM\(^8\). The SRM models hazardous events (that is, those that could lead to harm on the railway). Each is broken down into the precursors that could lead to its occurrence. The risk associated with each hazardous event and its precursors is estimated, and the results presented in terms of FWI per year. The SRM provides an estimate of the risk at a particular point in time and is updated periodically. Each month, the number of occurrences of each accident precursor is multiplied by the average consequence per event for that precursor (as estimated from the most recent version of the SRM) to give an estimate of the associated risk to be used in the PIM\(^9\). The risk from all precursors over the previous 12 months is then summed and normalised per million train km. The normalised figures are subsequently rebased against the annual average at September 2006. The risk level at the end of September 2006 is taken as the reference level for the PIM and is set at 100.

Train accident risk as measured by the PIM

The overall PIM results going back to 1999 are shown in Chart 1. The PIM covers 86% of the 8.4 FWI per year train accident risk predicted by SRMv7.

---

8 The SRM which is now at version 7 has been used extensively by the industry since 2001. The development of the SRM is governed by the cross industry SRM Practitioners Working Group which reports to the Safety Policy Group. The SRM has been subject to four external peer reviews over its life. The majority of the data used in the SRM is derived from the Safety Management Information System (SMIS). The data in SMIS is subject to the RSSB/industry data quality health check programme.

9 A slightly different approach is taken for SPADs and irregular working. The PIM indices for these groups are based on the risk ranking scores assigned to relevant events over the previous 12 months.
Rebasing of the PIM in 2012

In early 2012, the baseline for the PIM was changed from March 2002 to September 2006. The new baseline reflects the risk level after the introduction of TPWS and the removal of Mark I rolling stock. All previous PIM values have been recalculated so that trends over time can be assessed using a consistent dataset. Because of the rebasing, current PIM figures cannot be compared with those previously published.

Chart 2. Current PIM indicator v7 and new baseline Sept 2006

To show the potential effect of train accidents on passengers the PIM is now presented in public documents in the form of a passenger only chart as shown in Chart 3.

Chart 3. Passenger PIM indicator to June 2012 (SRMv7) Safety Risk Model (SRMv7)
The SRM enables us to estimate the vulnerability of the railway to low frequency but potentially high consequence events. Chart 4 shows how the predicted frequencies of accidents leading to >=5 fatalities and >=10 fatalities have changed since the SRM was first released in 2001.

It can be seen that:

- There has been a significant decrease in the predicted frequency of train accidents that could lead to multiple fatalities from SRMv2 to SRMv7.

- Recent reductions are due to a generally improving safety performance trend, as reflected in the SRMv7 train accident model results. Reasons behind this include the steps discussed in this paper such as TPWS / overall train crashworthiness.
Further info on SPADs and TPWS

Train Protection and warning system (TPWS) was implemented in the UK as an interim measure to reduce the consequences of SPADs, pending implementation of full protection through systems that monitor driver performance continuously. In the Uff-Cullen report\textsuperscript{10} it was envisaged that this higher level of protection would be delivered by the roll out of the European Rail Traffic Management System (ERTMS\textsuperscript{11}) within ten years. In the intervening period it has become clear that the roll out of ERTMS will take considerably longer and hence TPWS will be the primary means of mitigating SPAD risk for a period significantly beyond that originally envisaged. The huge reduction in SPAD risk shown in the ten year PIM, is due to the introduction of TPWS.

Reset and continue: A TPWS ‘reset & continue’ incident occurs when a train SPADs a signal, is stopped by TPWS, but the driver then resets the TPWS and continues forwards without the signaller’s authority. When this happens, the protection which was provided by TPWS is reduced. Since the installation of TPWS was completed in early 2004, there have been 26 ‘reset & continue’ incidents (most recent event occurred on the 1 October 2012 at Brereton). None of these have resulted in either a collision or a derailment, although in one instance the SPAD train did damage some points by running through them.

\textsuperscript{10} Prof. John Uff QC FREng and the Rt Hon Lord Cullen PC, \textit{The Southall and Ladbroke Grove Joint Inquiry into Train Protection Systems} (HSE Books, 2001).

\textsuperscript{11} For more information on ERTMS, see \url{http://www.rssb.co.uk/EXPERTISE/Pages/ERTMS.aspx} or \url{http://www.ertms.net/}
### Appendix D ‘Snapshot view’ of some of the ways in which sources of train accident risk are being tackled

<table>
<thead>
<tr>
<th>Risk from</th>
<th>PIM indicator</th>
<th>RSSB actions to support industry</th>
<th>Industry co-operative actions</th>
<th>Duty holder actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>3.8</td>
<td>Completed: T034 (Wind overturning), T060/T540 (Adhesion), T096/T371/T643 (safety impact weather/climate change), T112/T554 (Scour/flooding), T173 (rail temp), T796 (Sandals – adhesion), T1009 TrialCCA Research into Climate Change Adaptation, Underway: T797 (Sandals – adhesion)</td>
<td></td>
<td>Route Asset Management Plans have been developed and the implementation plan is in place. Longer-term updates to Asset Management policies are being developed for CP5. Development and implementation of tools to manage structural risk including a specific risk assessment process for management of adverse weather landslips.</td>
</tr>
<tr>
<td>Structural failures</td>
<td>8.2</td>
<td>Completed: T177 (OLE structure design to cater for collision), T305 (Defeatable structures), T360 (Structures and earthworks)</td>
<td></td>
<td>Improvement of understanding of asset degradation profiles through ORBIS.</td>
</tr>
<tr>
<td>LX failures</td>
<td>0.5</td>
<td>Completed: T023/T557/T613/T672 (RCF – rail), T066b/T115 (rail modelling), T076 (dentalments), T353/T792 (VTISM), T783 (SAC), T608 (INNOTrack), T889 (Q/D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track failures</td>
<td>4.5</td>
<td>Completed: T023/T557/T613/T672 (RCF – rail), T066b/T115 (rail modelling), T076 (dentalments), T353/T792 (VTISM), T783 (SAC), T608 (INNOTrack), T889 (Q/D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrong side signal failures</td>
<td>1.5</td>
<td>Completed: T023/T557/T613/T672 (RCF – rail), T066b/T115 (rail modelling), T076 (dentalments), T353/T792 (VTISM), T783 (SAC), T608 (INNOTrack), T889 (Q/D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runaway trains</td>
<td>4.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track speeding</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular loading of freight trains</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular working affecting level crossings</td>
<td>5.7</td>
<td>RSSB facilitated a meeting of Freight Technical Committee/ORR/Network Rail and has also completed knowledge search for ORR Pedestal suspension system for Gloucester Mk4 wagon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misrouting</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track management / maintenance issues</td>
<td>6.6</td>
<td>Underway: Underway: T797 (Sanders roadside adhesion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other signaler errors</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular working objects out of the line</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other irregular working</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train Accident risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public behaviour at level crossings</td>
<td>32.0</td>
<td>RSSB chairs the European Level Crossing Forum, to share good practice and coordinate public awareness campaigns (ILCAD) and encourages the EU to hold workshops on managing risk at level crossings. ELCF is also working with United Nations on Vienna convention on road signs. RSSB holds an annual road-rail information forum to update public groups on safety at the road-rail interface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public behaviour</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather related incidents</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td>0.3</td>
<td>Completed: T117 (accident survivability), T118/119 Whole train dynamic behaviour in collisions and improving crashworthiness, T189 Optimal design and deployment of obstacle deflectors and leguards, T180 Optimising driving cab design for driver protection in a collision, T120 – Review of measures to reduce risk from passenger train fuel tanks, T124 (tank wagon), T310 (injury causation – accidents), T358 (on-board accidents), T814 (GB-US rep), T961 (freight vehicle overturning). Underway: R441 Snowice (gritting at level crossings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objects on the line</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objects on the line due to vandalism</td>
<td>0.0</td>
<td>Anti-trespass and public behaviour initiatives to try to stop malicious placing of objects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-rail vehicles</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objects Blown on the line</td>
<td>3.2</td>
<td>Underway: R461 Snowice (gritting at level crossings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle incursions on the railway are managed by identifying incursion points through risk assessment of neighbourhood sites to the railway.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery of tree management programme, including working to updated standard NR/L2/TRK/3201 – management of lineside vegetation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working with BTP and reminders on cable/metal theft in Network Rail safety brief.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The table includes a brief summary of the actions being taken to address various sources of train accident risk, with references to specific projects and initiatives. The actions are coordinated by RSSB and involve collaboration with industry, governmental bodies, and international organizations. The table highlights ongoing efforts to improve safety at level crossings, manage irregular working, and address environmental and track-related risks.
<table>
<thead>
<tr>
<th>Risk from</th>
<th>PIM Indicator</th>
<th>RSSB actions to support industry</th>
<th>Industry co-operative actions</th>
<th>Duty holder actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAD</td>
<td>4.9</td>
<td>RSSB facilitates the current Operations Focus Group* (OFG) which has SPADs in their remit. Outputs produced on <a href="http://www.opsweb.co.uk">www.opsweb.co.uk</a>. RSSB developed the Risk Ranking Tool which is used by the industry to model the risk associated with SPADs. Complete: T796 Adhesion research - one of the recs on the TOCs to rectify defective sanders and to address sander maintenance in general. Underway: T797 (Sander – adhesion)</td>
<td>Engagement between Network Rail and the TOC/FOCs to enable sharing of best practice through OFG. OPSRAM (route level) and National Operational Risk Conference. Development and roll-out of ERTMS. ORR inspection of TOC low adhesion management pre-leaf fall season.</td>
<td>Network Rail reinforces the message on SPADs through RED Alert and associated DVDs.</td>
</tr>
<tr>
<td>Brakes</td>
<td>0.8</td>
<td>Completed: T685 (Brake systems/mass), T796 (Sanders – adhesion), T877 (WSP) Completed T634 (fuel tank), T843 (TS45545 fire std)</td>
<td></td>
<td>Maintenance regimes are standard procedure across the industry to ensure axle bearing failures are picked up.</td>
</tr>
<tr>
<td>Fires due to rolling stock failures</td>
<td>0.4</td>
<td>Completed: T685 (Brake systems/mass), T796 (Sanders – adhesion), T877 (WSP) Completed T634 (fuel tank), T843 (TS45545 fire std)</td>
<td>The Rail Technical Strategy (RTS) sits with the owners and operators of the railway. The Technical Strategy Leadership Group (TSLG), a cross-industry expert body supports communication, managing strategic research, identifying opportunities, barriers and actions. TSLG oversees the work of the industry’s Systems Interface Committees (SIC) and other groups with pan-industry technical development roles. Rail Notices system for sharing information on train and component defects. NIR-Online helps rail industry companies to share their experience and best practices with regard to engineering and safety.</td>
<td>New trains are also tested to ensure they have adequate running capabilities in case of fire to get it to a safe place for evacuation.</td>
</tr>
<tr>
<td>Fires due to vandalism</td>
<td>0.3</td>
<td>Completed: T796 (RCM – Acoustic axle bearing monitoring), Underway: T728/T774 (Axle corrosion / inspection).</td>
<td>RISAS and developing Supplier Assurance projects for giving assurance about manufacturers / maintainers. Research has shown that there is an opportunity to capture an estimated annual time-cost saving of £35million, which broadly equates to some 375 person years of effort, by making supplier assurance arrangements more simple, effective and efficient.</td>
<td>Chairs and interiors on trains are now designed to be more fire resistant. EN45545 gives the material properties of the chair covers on trains so that they are not prone to catch fire or emit poisonous vapours when vandalised.</td>
</tr>
<tr>
<td>Other train fires</td>
<td>0.3</td>
<td>RISAS and developing Supplier Assurance projects for giving assurance about manufacturers / maintainers. Research has shown that there is an opportunity to capture an estimated annual time-cost saving of £35million, which broadly equates to some 375 person years of effort, by making supplier assurance arrangements more simple, effective and efficient.</td>
<td>Under frame washers have now improved to reduce the greasy nature of diesel engines and other under-train equipment.</td>
<td>Maintenance regimes are standard procedure across the industry to ensure axle bearing failures are picked up.</td>
</tr>
<tr>
<td>Hot axle box</td>
<td>0.0</td>
<td>Annual time-cost saving of £35million, which broadly equates to some 375 person years of effort, by making supplier assurance arrangements more simple, effective and efficient.</td>
<td>Hot axle box detectors (HABD) are now being replaced by acoustic bearing monitors whose working is superior to the HABD. In addition to this European TSIs mandates that when a train runs faster than 250kph, there should be an on board monitoring system that would alert the driver when the axle box gets hot in addition to any track side equipment.</td>
<td>The design of rolling stock largely driven by the requirements in RGS such as vehicle crashworthiness; energy absorbing front ends and visibility for front end cab windows. IT systems for recording wagon/container loading to assist with reducing track/vehicle deterioration.</td>
</tr>
<tr>
<td>Other rolling stock failures</td>
<td>3.3</td>
<td>Annual time-cost saving of £35million, which broadly equates to some 375 person years of effort, by making supplier assurance arrangements more simple, effective and efficient.</td>
<td>The design of rolling stock largely driven by the requirements in RGS such as vehicle crashworthiness; energy absorbing front ends and visibility for front end cab windows. IT systems for recording wagon/container loading to assist with reducing track/vehicle deterioration.</td>
<td>Maintenance regimes are standard procedure across the industry to ensure axle bearing failures are picked up.</td>
</tr>
<tr>
<td>Total</td>
<td>88.1</td>
<td></td>
<td></td>
<td>Maintenance regimes are standard procedure across the industry to ensure axle bearing failures are picked up.</td>
</tr>
</tbody>
</table>

*OPG*