12. The Infrastructure

How to manage the engineering interfaces between vehicles and infrastructure relationships, preventing problems before they start.

12 The Infrastructure

12.1 The Engineering Interfaces

The systems involved: There are many engineering interfaces between vehicles and infrastructure that can affect train performance if they do not work together effectively. The performance impact can be immediate, for example a wrong-side AWS failure that causes train delays and cancellations, or it may be subtle and not become apparent for a long period of time after substantial degradation of the vehicle, the infrastructure or both, resulting in greater performance impact and the need for repair investment (e.g. rolling contact fatigue [on both infrastructure and vehicles]).

The main engineering interfaces between rail vehicles and infrastructure are summarised below:

- Wheel and rail (wear and adhesion)
- Signalling control (AWS, TPWS, ERTMS, ATP)
- Current collection (overhead line equipment (OLE), 3rd rail equipment)
- Loading Gauge (static and dynamic)
- Telecommunications (GSM-R)
- Infrastructure-based vehicle health monitoring systems (hot axle box detectors, wheel impact load detectors, pantograph uplift detectors)

Indirect engineering interfaces: Whilst most engineering interfaces are obvious, e.g. wheels on rails or pantographs under OLE, train performance can be influenced by interaction between vehicles and infrastructure that is less obvious. Identifying these interactions and opportunities to improve train performance can be more difficult, but regular liaison and strong working relationships between TOCs and Network Rail help.

Example: AGA train performance suffered from a high number of AWS code 10 failures at a platform on Ilford station (10 incidents in 3 weeks) and all resulted in train cancellations. There was no AWS signalling equipment in the area concerned and the signal engineer was convinced that there was no infrastructure interaction involved. However, the relevant NXEA fleet performance engineer raised the issue with the Anglia Rail vehicle interface engineer who appreciated how both sides of the system worked and undertook a more thorough review. This joint investigation identified that the most likely cause was a 60-foot length of new rail that was stored in the 4 foot, where the rail end was partially magnetised and located such that it was visible to the AWS receiver when vehicles were stopped at the platform. The RVIE escalated the issue within Network Rail; the rail was removed from the 4 foot and no further AWS code 10 incidents have been reported.

Relationships: To ensure trains and infrastructure interact safely, many engineering standards are focused on the design and maintenance of the railway system, e.g. the flange height and thickness of a wheel profile or the gauge and alignment of track. There is less focus on the wider aim of good performance and very little guidance or standardisation available when it comes to getting the most out of these interfaces and improving performance.

The variety of engineering factors and duty cycle demands on vehicles and infrastructure in the UK make generic solutions difficult to achieve. Capitalising on the assets at these interfaces requires asset stewards to work together, monitoring them and developing performance improvement plans where problems arise.

To enable the cross-company engineering relationship to be more effective, Network Rail has a team of rail vehicle interface engineers (RVIEs) with a remit to establish the engineering root cause that includes improving performance and safety around the engineering interaction of vehicles and infrastructure. This team is embedded in the Network Rail organisation and focused on engaging with TOCs to identify and facilitate the delivery of performance improvement through better understanding and knowledge-sharing across the engineering interfaces of vehicles and the infrastructure.

12.2 **RVIE core activities**

12.2.1 **Rail vehicle monitoring**

Purpose: Rail vehicle monitoring is undertaken to reduce risks, maintain safety, prevent accidents and improve performance on the rail network. It records incidents in a dedicated database, which are then subsequently resolved through liaison with the relevant stakeholders.

It is recognised that the database is not an exhaustive list of all rail vehicle imported risk incidents.

Benefit: Improved safety and reliability of the infrastructure with more efficient assets and maintaining the reputation of stakeholders to deliver a service to passengers.

General: Control centre incident logs (CCIL) are used as the primary (but not exclusive) source of information.

Incidents that carry the potential to import risk into the infrastructure are recorded under the following categories:

- Axle and axle bearing failure incidents
- Brake failure incidents
- Collision incidents
- Vehicle derailment incidents
- Vehicle component detachment incidents
- Train division incidents
- Vehicle door incidents
- Vehicle environmental incidents
- Vehicle fire incidents
- Train signal systems incidents (AWS, TPWS, ATP, ERTMS)
- Defective wheel/tyre incidents

Rail vehicle interface engineers liaise with railway undertakings to understand the root cause and confirm that incidents have been resolved. This is subject to co-operation from the relevant railway undertakings. Details of resolution and/or long-term mitigation to prevent re-occurrence are recorded in the database. Incidents are closed out in the database. A route-based period report is prepared showing confirmed imported risks and steps that have been taken.

In addition, the database is used as a tool for recording vehicle performance issues that do not import risk into the infrastructure for ad-hoc monitoring requirements and trend identification.

> Example: GWR chair the ATP user group and are recognised as having industry expertise in this train borne system.

Technical support

Purpose: Provision of engineering expertise to support internal and external stakeholders to improve performance, safety and efficiency at the interface between rail vehicles and infrastructure.

Benefit: Provision of expertise reduces time spent by non-vehicle specialists and enables expedient resolution of commercial claims.

General:

- Work with TOC fleet team and Network Rail engineering and maintenance teams to improve performance by resolving joint interface issues
- Take part in formal investigations into serious incidents involving rail vehicles
- Review and validation of TOC claims for damage to vehicles where Network Rail is responsible
- Providing technical support to route commercial teams
- Monitor implementation of HLOS schemes on rail vehicles
- Delay resolution assistance – fleet
- Work with TOC and route enhancement team to validate HLOS/CP4 fleet schemes
- Reporting to route director on any infrastructure-related issues and in-depth analysis of any proposed changes to rail vehicle operations in the route (NETWORK CHANGE) compatibility forum
- General vehicle technical data enquiries
- Interface working groups
- Sharing best practices and new technologies

Example: Southern and NR are developing a joint process to be facilitated by RVIE where investigations into engineering root cause are concluded within seven days. This joint approach will save industry time and focus on resolution, eliminating the need for independent investigations.

Example: Sharing data and knowledge from new and existing technologies to improve the reliability of our network, i.e. pan monitoring on LNW Pendolinos, new RETB base stations in Scotland, third rail interface monitoring equipment on Southern Electrostar.

12.3 **Customer liaison**

Purpose: To build and maintain close working relationships between internal and external stakeholders to provide a platform for communication, understanding and resolution of rail vehicle risk and performance issues.

Benefit: Engineering staff in the TOC and NR can discuss and resolve engineering issues, enabling reduction in risk and increase in performance. RVIE is a team of experienced and skilled engineers that can provide resources for investigations that may not exist elsewhere.

General: Liaison should be regular according to the business requirements of all stakeholders. There should be further liaison when required utilising all communication links available.

Example: Southern fleet technical services alerted RVIE to a wheel damage problem on their fleets; small indentations were seen at various locations around the circumference of one side of the train's wheelsets. Southern supplied possible locations to check on the infrastructure, RVIE pursued track engineers and the location of the problem was found with matching rail damage. Although the exact cause was not identified, it is thought to have been a small piece of hard material which was later picked up by a train wheelset and dropped elsewhere, as there were corresponding indentations found on the rail head at 2.5m intervals. Southern carried out independent testing and confirmed the wheel damage was fine to continue until run out by normal running

Example: ScotRail reported an aggressive flange wear problem affecting their fleet. RVIE pursued maintenance and maintained daily contact with the delivery units and ScotRail to ensure daily actions and updates until the problem was resolved.

Example: RVIE offers everyone in fleet an "in" to NR. It has often been stated that having a single point of contact is a great asset.

12.4 **Interface working groups**

Purpose: To improve the performance of the interface by identifying areas of poor performance and to ensure that Network Rail and the train operators are working together.

Benefit: Identification of interface performance status leading to improvements in asset life for both rail vehicles and infrastructure; knowledge hub of system interface engineering; close working relationships with stakeholders.

General:

- To establish root causes
- Identify jointly beneficial solutions
- To provide a focal point for groups to input interface issues as they arise
- To share knowledge and best practice
- To improve the efficiency of the network resulting in a reduction in delay and cost to the industry
- Improve customer satisfaction
- To identify interface capabilities and limitations, challenge those where appropriate
- Harmonise vehicle/infrastructure interaction

Example: First Capital Connect (now GTR) reported that wheel flanges were not as populated with grease as they had been previously and enquired to RVIE in the Anglia route. RVIE alerted track engineers who found a faulty flange lubricator and scheduled an immediate repair, preventing a much larger issue of rail and wheel damage.

12.5 **Preventing engineering interaction problems before they start**

The Network Rail RVIE team is also able to provide engineering support, bringing the right engineers together, e.g. when identifying the impact of train modifications or new fleets on the compatibility between trains and the infrastructure. Whilst there are formal processes for this, e.g. assessment of compatibility as per GM/RT8270, the local RVIE can engage with the local infrastructure engineers during the early stages of the engineering change process to identify any issues that can be resolved in advance of committed work being carried out. It is important to recognise that this collaboration sits alongside the formal process of ensuring compatibility between both asset types.

Example: The Anglia RVIE provided technical support to NXEA, assisting in the assessment of compatibility of their Class 360 fleet for route clearance to the new Orient Way sidings.