Strategy for regulation of health and safety risks – chapter 14: Tramways

ORR's Strategy for the tramway sector

ORR expects all those associated with tramways, including operators, maintainers and owners, to have in place suitable and sufficient safety management systems (SMS) that allow them to properly identify and keep under review the risks inherent in their systems and have in place the necessary controls to manage those risks, whether this is through infrastructure and systems, or through operating practices. We expect the industry to monitor for opportunities for improved risk control, such as offered by rapidly developing technologies, and pursue such opportunities where reasonably practicable,

To help achieve this ORR will:

With the Tramway Sector

- Promote the role of leadership in creating a strong learning culture that is capable of regularly reviewing health and safety performance, and being able to take prompt action to prevent accidents and improve risk control;
- Support the GB tram industry's work in developing arrangements to enable more effective cooperation on health and safety matters;
- Support the sector's work to better understand safety risk associated with tramway operation to ensure that appropriate guidance and standards are in place for the GB tramways;
- Encourage the sector to use the risk management maturity model (RM3); and the sector developed risk models and reporting systems as a means to identify success and areas for improvement;
- Push the industry to apply the hierarchy of risk control, with the elimination of risk at source and move towards further engineering control to reduce the reliance on human performance in systems through the principles of safety by design at scheme, vehicle, and component level (see chapter 12 Safety by Design);
- Keep the regulatory framework under review so as to ensure that it remains valid in light of significant developments.

With individual Dutyholders

- Continue to carry out planned inspections & reactive investigations; and assess the evidence captured against the Risk Management Maturity Model (RM3) to build a clearer more in-depth picture of dutyholder's health and safety management capability;
- Continue to give specific attention to ensuring that dutyholders continue to deliver actions they identified to implement the requirements of the RAIB Sandilands report and other relevant RAIB recommendations, with particular focus on actions to prevent high consequence events occurring;
- Promote improved levels of safety reporting and investigation within individual tramway systems, enhanced quality of safety reporting to the regulator, and better sharing of safety learning to other parties in the sector; and
- Where necessary take enforcement action in accordance with our enforcement policy.

Vision

We expect the tramway sector to deliver continual improvement in the health and safety of passengers, workforce, and the public to achieve ORR's vision of *"zero industry caused fatalities and major injuries to passengers, the public, and the workforce".*

We believe that for the tramways sector to achieve this it should:

- Have a strong central body providing safety leadership to the industry, setting standards and good practice drawing on the experience of the GB operators, and learning from across mainland Europe and the rest of the world;
- Keep under review the possibilities for improving risk control and taking a proactive approach to embracing appropriate risk control technologies, including from other transport sectors;
- Have an evidence-based approach to modelling the risks inherent in their systems and which puts in place reasonably practicable measures to mitigate those risks;
- Use established methods to measure its own health and safety performance and which takes actions to improve on the basis of those assessments;
- Establish sensible performance benchmarks for health and safety performance that the sector can measure themselves against;
- Develop an improved culture of cooperation and sharing of safety related information between systems to help the overall performance of the GB tramways.

Index of issues discussed

Introduction and context

What is Light Rail?

1. “Light rail” is a term used to describe an urban rail transportation system that generally uses electrically powered, rail guided vehicles. To allow greater flexibility in integrating systems into the urban environment, light rail systems generally use lighter equipment operating at slower speeds than a mainline railway or heavy use metro/urban railway.

2. Tramways are a form of light rail system intended for local passenger movement that have a significant element of the system operating in a highway environment or other public space that may in places be segregated from other vehicular traffic. Newer systems usually include private rights of way and a variety of operating environments, including street, segregated and off street.

3. Off street environments can sometimes include characteristics common with mainline rail or heavy use metro/urban railways, such as similar track forms and significant structures such as viaducts and tunnels. This can often be the case where a new tramway takes advantage of a previously abandoned rail route.

4. Fundamentally, many of the risks that the tramway sector manage are similar to those of mainline rail or heavy use metro/urban railways. There are however several notable differences that introduce particular hazards.

5. The most significant difference is the principle of operation. Unlike mainline rail or heavy use metro/urban railway where train movements are regulated by signalling systems that provide the driver with permission to proceed as far as the system can be assured the track is clear, trams are driven on ‘line of sight’ in a manner similar to road vehicles. This offers greater operational flexibility allowing, for example, trams to travel closer together but within the stopping capability of the vehicle. Tram drivers are required to operate the tram at a speed that

allows them to stop the tram in a distance that they can see to be clear ahead. This is the same principle of operation that road vehicle drivers apply and allows trams to operate in close proximity to pedestrians and road vehicles. Conflict points, such as intersections between tramways, roadways and footpaths are designed and operated on highway principles.

6. Tramway design takes account of these factors through specific requirements. A significant difference to 'traditional' rail vehicles is the tram's capability to stop in a significantly shorter distance by the use of electromagnetic track brakes. Trams are also lighter, have improved visibility, and 'pedestrian friendly' design features.

7. This chapter focuses on our strategy for regulating Great Britain's modern tramways, and complements our topic specific chapters that are relevant across the rail sector. It identifies the significant characteristic of tramway operation that create specific risks that are either not relevant to mainline rail or heavy use metro/urban railways, or that we consider to be a high priority for the tramway sector.

8. We will review this strategy once the output of the sector's review of operational risk is available, this being implemented as part of its development of a new safety risk model. We will also review the strategy once the learning from the trial tram-train service between Sheffield and Rotherham has been published and evaluated.

9. This chapter is not intended to apply directly to the GB heritage tramway systems, though in regulating these systems we would draw on the principles in this chapter in a proportionate manner.

10. Tramways present a different model for ORR compared to the mainline rail or heavy use metro/urban railways. The mainline railway is centred around Network Rail as the Infrastructure Manager with the various passenger train franchises and freight companies as operators on that network. The Department for Transport and Transport Scotland fund much of the infrastructure development and maintenance, but generally sets quite broad infrastructure requirements. Heavy use metro/urban railways such as London Underground Ltd are a registered corporate entity functioning within an overarching function of a Statutory Body – Transport for London. In contrast, the development of new tramway infrastructure is normally driven and specified by public sector organisations such as local authorities. Local authority bodies that own the existing systems can also have significant control in directing investment decisions. There are a number of different ways this relationship is structured in different systems and in some cases these bodies are not 'undertakings' in a regulatory sense. In some instances this can constrain ORR's powers to influence these ultimate owners of the systems and enforce upon them. Consequently, ORR has to operate through cooperation and ensuring clarity on rules and standards that we expect to see applied, or by enforcing upon the operators even though they may be limited in the response they can make.

11. While the design of tramway infrastructure can conform to normal GB expectations for street and infrastructure design, many of the mechanical and electrical systems (in particular those in vehicles), have to be purchased from supplier's established product ranges. In most instances, there are a number of suppliers all working around a common set of EU and

international standards. However, the number of suppliers producing tram vehicles is smaller, with no volume manufacturer working solely in the GB market.

12. Trams are not generally built bespoke for each system on an order by order basis. Manufacturers have a set of common core designs that are adapted to the needs of each client and order. Often the adaptation is as minimal being limited to such things as the choice of paintwork and seating materials. GB tram sector specific standards that materially diverge away from European norms can have a disproportionate impact on the cost and availability of new tram vehicles. There is a risk that tram vehicles purchased solely for the GB market with GB-only specific requirements will require costly features to be added to standard designs. Therefore, it is important that the tram sector fully understands the risks associated with the operation of tramways, such that it can make 'reasonably practicable' safety improvements based on sound evidence of the level of risk and costs of intervention.

History of modern tram sector

13. Until 1992 Great Britain's only remaining 'first generation' tramway was in Blackpool, operating since 1885. During the early 1990s two 'second generation' tramways commenced operation in Manchester and Sheffield. These were followed by systems opening in Croydon and the West Midlands in the late 1990s and Nottingham from 2004. Since then several systems have continued to grow, most notably Manchester, and in 2014 the Edinburgh Tramway commenced operation. Across the GB system, passenger numbers have increased year on year since 2009/10, growing by over 50% to 2017/18. The scale of each operation differs: in 2017/18 London Tramlink and Manchester Metrolink account for just under 60% of all passenger tramway journeys.

14. Annex 2 provides key information for each system; annex 3 a comparison with other railway systems in GB.

15. In 2011 the Department for Transport published their paper "Green Light for Light Rail" which summarised the case for light rail and tram systems and drew on earlier reports from the National Audit office and Public Accounts Committee amongst others. The report highlighted the various advantages that light rail can have where it operates in corridors with high passenger demand:

- improving penetration of town centres compared to heavy rail,
- supporting regeneration and urban development,
- giving passengers a service with dependability and perceived quality above that of bus,
- contributing to de-carbonisation and removing emissions at street level, and
- improving accessibility of public transport for those with disabilities.

The report also focused on some of the cost issues, particularly the perceived high capital costs of construction and the lack of standardisation. The report was optimistic about the role of light rail in the mix of transport options but emphasised the need to reduce costs, simplify and standardise.

16. The trend in RIDDOR reportable accidents is shown in the table below. The figures in 2016/17 encompass the overturning of a tram at Sandilands on the Croydon system where seven people died, 19 were seriously injured, and 43 had minor physical injuries.

		2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Passenger	Fatality	0	0	1	1	0	0	0	7	0
	Major Injury	2	3	4	2	6	4	3	26	6
	Minor Injury	40	33	40	38	33	18	12	49	14
Public	Fatality	0	1	2	2	2	1	1	1	1
	Major Injury	3	2	2	3	2	2	2	1	2
	Minor Injury	10	7	4	15	6	14	8	9	7
Worker	Fatality	0	0	0	0	0	0	0	0	0
	Major Injury	3	1	0	5	2	3	2	3	2
	Minor Injury	21	11	14	14	8	11	11	21	17

Data drawn from incidents reported to ORR under the RIDDOR reporting regulations.

Table 1: Volume of injuries: Passenger, Public & Workers on GB tramways, 2009-18

17. During 2017-18, reported workforce injury trends show a slight upward trend, with public safety trends remaining at low levels. In all injury categories the outcomes are dominated by incidents arising from slips, trips and falls either on the infrastructure or on board moving trams. Of those fatal accidents to members of the public reported to the ORR, a significant number were identified as intentional acts.

Differences to heavy rail, and impact that has on risk management

Method of operation

18. The key philosophy that underlies the way in which tram systems are designed and operated is that traditionally the operating principles have been more closely aligned to those of bus systems than they have been to the operating principles of railway or metro systems. This difference in operational philosophy is often not well articulated but the effect is pervasive through the system specification, design and method of operation, particularly in terms of tramway layout and system of control. These in turn have an impact on the way in which the vehicles operate across the system. Conflict points with other vehicles and pedestrians, such as at road junctions and footpath crossings, are designed and operated in accordance with highway principles.

19. This is most obvious in the sections of tramway that operate on streets with pedestrians, cyclists and road vehicles. Tram operation is consistent with the speeds, signs, signals and rules of the road that apply to other roads users, such as a bus, car, van or lorry.

20. These operational rules are generally also then followed in off-street sections, even though the route may appear more like a railway alignment. In these contexts, the tram could be considered similar to a guided bus operation.

21. This reliance on the consistent use of the 'line of sight' principle of operation puts an increased dependence on the tram driver to conform to operational rules and regulations of the highway and the tramway. This includes controlling tram speed and adherence to signals and signage. By comparison, for example, a train driver operating on the mainline has systems intended to ensure a clear unobstructed route ahead and engineered systems to ensure compliance with signals and obedience with speed limits at higher risk locations. Tramways therefore have an intrinsic dependence on consistency of human performance. Again, this is similar to buses.

22. Tramways also require arrangements to be in place to ensure infrastructure (tramway or third party), environmental, and operational changes do not compromise the line of sight operating principle.

23. This underlying principle of tramway operation must be understood by all those who design tramway systems and equipment to ensure that it functions as a coherent system. Where designs, or designers, are imported from a mainline railway or metro background risks can be introduced by the use of inappropriate non-tramway thinking.

Conflict points

24. While tram vehicles can have many similarities to buses and coaches, a fundamental difference is the tram's inability to steer around an obstruction (such as car or pedestrian) that suddenly enters the path of the tram vehicle when very close. This inability to steer, arising from the fact that the tram runs on rails, also results in the tram attempting to follow the track alignment, irrespective of speed, or appropriateness of that design alignment. The lateral restraint provided by wheel flange contacting the rails will increase the risk of overturning at high speed.

25. These factors require those building a tramway to consider these types of third party actions during the design phase and those operating it ensure that operational arrangements are in place to enable tram drivers to drive defensively and perform active hazard spotting.

26. Although tramways can control the nature of the crossing point, they have limited ability to directly control the design of the approach or behaviour of approaching road vehicles and pedestrians. Tramway organisations need to work with adjacent landowners, such as local authorities, who do have responsibilities in these areas to reduce the risks of pedestrians, cyclists and vehicles approaching the tramway in ways that result in unsafe behaviours.

27. The limited ability of the tramway companies to control activity beyond their specific infrastructure can also extend to issues around maintenance, particularly of the road surface

and associated road markings that are often a responsibility of the highway or roads authority rather than the tramway.

Interface

28. Tramway operation has an increased level of interface with vehicles and pedestrians compared to railway operation. This is managed through a combination of design and layout of the infrastructure, lower tram speeds, active warnings, and tram vehicle design to mitigate the effects of collisions. Together these factors reduce the level of the forces created during a hazardous event.

29. Compared to mainline rolling stock, it is the reduced level of kinetic energy and force in collision events that allows tram vehicles to be constructed with lighter body structures. Lower overall vehicle weight results in reduced imposed loads onto the rails and supporting structures, which in turn can allow the use of lighter and simpler structures.

The law

30. ORR is the national safety authority for tramways. The Health and Safety (Enforcing Authority for Railways and Other Guided Transport Systems) Regulations 2006 (as amended) describes the extent of ORR's health and safety enforcement functions in relation to tramways and associated infrastructure.

31. There is no specific health and safety legislation for tramway systems. The Tramways Act 1870 was repealed in 1992 under the Transport and Works Act of that year. The Health and Safety at Work etc. Act 1974 (HSWA) remains the overarching health and safety legislation relevant to managing the safety of persons using or affected by the operation of tramways. However, there is legislation relating to highways that affects tramways, in terms of both design and operation.

32. The construction of new tramways and extensions to existing systems rest largely in the enforcement of the Health & Safety Executive (HSE) as they are conventional construction work. ORR has delegated powers from HSE to look at the implications for operational safety at the time of design and construction.

33. Once in operation ORR is the health and safety enforcing authority for the 'operation of the tramway', however where a tramway operates within a highway environment there will be aspects of the street environment that are outside of the control of the tramway and hence out with ORR's enforcement vires; these will fall normally to the HSE but in some cases may fall to a local authority. At interface areas such as crossings, ORR will expect to work closely with other regulators when necessary.

Railway legislation

34. There are a number of statutory instruments made under HSWA that expand on the general HSWA principles, most significantly the 'Railways and Other Guided Transport Systems (Safety) Regulations 2006' (ROGS). ROGS requirements for tramways are different than those for mainline or other non-mainline railways. These are summarised below;

- **Written safety management system:** Tramways must establish written safety management systems (SMS) proportionate to the nature and extent of their activities. This is the same as for mainline railways and metros. However, tramways (excluding tram-train) are not required to have safety certificates or safety authorisations issued by ORR before they start operation. As tram-train operates on the mainline network, they require to hold a safety certificate, however to ensure a proportionate approach is taken, the safety certificate is non-mainline rather than the mainline equivalent. Where different companies undertake the operation and maintenance of a tramway each is required to have their own SMS for the activities that are their responsibility and need to cooperate to achieve overall safety of the system.
- **Risk assessment:** In line with non-mainline railways, tramways must have a risk assessment process for introducing change that meets the specific requirements of ROGS and apply safety verification involving independent competent persons when required. This is different to the mainline railway, where safety verification has been replaced by the EU Common Safety Method for Risk Assessment (that includes independent scrutiny).
- **Approval of new works:** ROGS does not provide any formal role for ORR to approve proposals. Unlike the mainline railway, the tram sector is subject to safety verification and competent person requirements when making significant changes to tramcars and infrastructure. However some legacy arrangements remain. Formal approval requirements for changes to tramways are not universal, and vary between the Acts and Orders that provided the systems with statutory authorisation. Where approvals are required, ORR is involved on behalf of Ministers. The mainline railway requires ORR to authorise new or major upgrades to rail vehicles and infrastructure under interoperability legislation.
- **Duty of Cooperation:** the different parties involved in the operation and maintenance of tramways have a specific duty to cooperate to achieve safe operation of the tramway system.

Requirements under other legislative provisions:

- **Safety reporting:** In common with non-mainline railways, there are no additional safety reporting requirements on tramways, other than those set out in RIDDOR. Mainline railways are required to submit an annual safety report to ORR, including a statistical return against EU common safety indicators; tramways are not required to do this.
- **Unauthorised access:** The Railway Safety Miscellaneous Provisions Regulations 1997 include a requirement under Regulation 3 that ‘where and to the extent necessary for safety, that unauthorised access to [Transport System] infrastructure is prevented.” The regulations specifically define ‘transport system’ to exclude a system that “runs along and at the same level as a street or in any other place to which the public has access (including a place to which the public has access only on making a payment)”. Tramways operating in street environment are therefore

outside the scope of this regulation. Where tramways operate in segregated areas they are still not necessarily treated the same as railways due to the 'to the extent necessary for safety' term; a mainline rail vehicle travels at high speed and cannot brake to avoid a collision with a person or vehicle on the track ahead and so there is an expectation that a railway would almost always be expected to have a secure boundary, usually a fence. For a tramway, where drivers are always expected to be travelling at a speed where they are able to bring a vehicle to a halt within the distance that they can see to be clear ahead, a fence is not necessarily required. Decisions on boundary management on segregated tramways are inevitably location specific and require appropriate risk assessments to be undertaken, though the default in a line-of-sight system would be that fencing is not normally required.

- **Train protection systems:** Tramways are outside the scope of the Railway Safety Regulations 1999 due to the definition of 'railway' in the schedule to the regulations. This means that they are not obliged to comply with the same rules as railways where a 'train protection' system has to be provided that applies brakes if a stop signal is passed that could lead to a collision, or the train travels at excessive speed. While tramways are not obliged to comply with these regulations it is necessary for tram systems to be able to show they have carried out the risk assessments and implemented appropriate measures to control such risks.

35. We reviewed the regulatory framework for tramways, and published our findings as part of our response to RAIB's recommendations made following the Sandilands accident. Whilst not recommending any change to the framework summarised above, we are exploring opportunities to strengthen its application.

Highway legislation

36. Tram vehicles are excluded from compulsory compliance with the same rules around construction as other road vehicles through the provisions of the Tramcars and Trolley Vehicles (Modification of Enactments) Regulations 1992. These regulations also impose a requirement for tram drivers to hold a class B driving licence, i.e. for a car.

37. ORR has always recommended that tramcars should be built and maintained to comply as closely as possible with comparable rules for large passenger vehicles, e.g. buses and coaches, to ensure that trams are consistent with other road vehicles; this helps to reduce the risk of confusion to other road users who may not be familiar with tramcars.

38. The Highway Code contains specific advice to road users about tramways and how to interact with the vehicles and infrastructure safely.

39. The signs, signals and road markings relevant to tramways when in a street environment are set out in the Traffic Signs Regulations and General Directions 2016, supported by the guidance in the DfT's Traffic Signs Manual.

Guidance and standards

40. In 1989 the Department of Transport produced the “Provisional Guidance Note on the Highway and Vehicle Engineering Aspects of Street-Running Light Rapid Transit Systems”. This was updated to a new document when ORR’s predecessor HSE issued the ‘blue book’ of Railway Safety Principles and Guidance Part 2 (RSP2) Section G “Guidance on Tramways” in 1997 (ref: HS(G)153/8). ORR reissued this in November 2006 as Railway Safety Publication 2, with the same title “Guidance on Tramways”.

41. In 2015 ORR entered an agreement with UKTram, the trade body for tramways in the British Isles, to update and republish RSP2; this work was completed in early 2018 with the publication of “Tramway Safety Principles”. The updating of the document has involved direct input from experts in the industry and takes account of learning from practical experience of construction and operations since RSP2’s predecessor was first written in the 1990s. The update is also intended to address learning and recommendations from RAIB investigations. UKTram and the Light Rail Safety and Standards Board (LRSSB) are now gathering comments on this first issue of the document with a view to an update in 2019.

42. UKTram produces a number of other guidance and good practice notes.

43. ORR supports the use of standards from other EU countries where these are appropriate to the GB legal context.

44. The GB tramway industry is currently establishing a new body separate from UKTram to manage the collation of safety data from GB tramways, promote cooperation and research activity, and develop and maintain standards for the sector. This body is known as the Light Rail Safety and Standards Board and funding was announced by DfT in February 2019. Once fully operational it is expected that UKTram documents such as “Tramway Safety Principles” will transfer to the management of the LRSSB.

Issues around trams and tram operation

45. Key risk topics for the tramways sector are addressed in a number of ORR’s strategic chapters. Annex 1 expands on these chapters to highlight key issues relevant to how tramway practice may result in hazards that are different to those of the wider railway or metro systems.

The Challenges

46. There are a number of challenges that can impact on the efficacy of the management of safety risk in the tramway sector:

- Tramways remain a relatively small sector and this limits the overall available pool of expertise.
- The operation of tramways remain inherently reliant on the competence and fitness of drivers for the control of the vehicles. As with road vehicles the primary risk control mechanism is the driver;
- The disparate nature of the GB’s independent tram systems and their operators’ means that they do not have common pressures for consistency and standards that

are seen in the mainline railway or heavy use metro/urban railway. This presents a challenge to the industry's central bodies, UKTram and the new LRSSB, to deliver common and shared understanding of the sector's risks and control measures, and minimum standards and strategic safety leadership for the industry;

- While technology to monitor and support tram driving is a rapidly developing area its emergence is relatively new, and the industry needs to work together to assess and evaluate which technologies can offer the most suitable assistance, to increase the reliability of line of sight operation, and help reduce risk exposure;
- The supply of vehicles and other key systems from a small number of EU and International suppliers limits the degree to which GB specific requirements can be applied without increasing costs beyond reasonable practicability; consequently requirements must be subject to rigorous risk assessment and cost-benefit analysis;
- Passenger growth continues across all the GB tramway systems, putting pressure on systems, infrastructure and staff. This comes at a time when some tramways are already reaching the age where some equipment and systems are becoming life-expired or requiring mid-life refurbishment. Managing upgrade and replacement in increasingly highly loaded transport networks presents operational and safety challenges to the companies involved;
- Given their operation in areas with pedestrians and road vehicles, tram systems are dependent on their safety performance on not only their own maintenance and operations, but also the use of and interaction with the tramway by the public. The level of misunderstanding or deliberate violation of safe behaviours when interacting with tramways can have significant influence on the level and severity of safety incidents on tramways.

ORR activities and priorities

47. Informed by our assessment of key risk topics set out in annex 1, and our risk assessment risk-ranking toolkit, we identified the key priority areas for engaging with the industry. These are:

- Carrying out proactive inspection to check the appropriateness of tramway Safety Management Systems to ensure that these meet the ROGS requirements, and verify effective implementation of risk control arrangements;
- Investigate selected incidents to establish if there have been breaches in health and safety law, to identify lessons to be learned in the management of risk, and to ensure suitable corrective actions are identified and acted upon;
- Assess how tram operators are undertaking risk assessment and that these arrangements are suitable and sufficient for their activities;
- Work with the sector as a whole to gather better data on safety performance;

- Ensure tramway organisations are looking for opportunities to identify potential safety improvements, and that companies pursue these where reasonably practicable. Issues might include aids to drivers, safety of public crossings and public education;
- Monitor the work being undertaken across the sector to increase reliability of Line of Sight Operation working, and ensure that emerging good practice is collected in appropriate guidance documents, publicised and promoted;
- Work with the tram operators on the implementation of recommendations from the RAIB investigation report into the accident at Sandilands in 2016. While some elements are specific to the Croydon system, many apply to the sector as a whole;
- Develop principles for technologies to support driver alertness and attention;
- Work with and support UKTram and the LRSSB in the review and development of risk model and industry guidance, and delivering safety leadership to the sector, including their role to collect and share lessons learnt and good practice between systems; and.
- Where appropriate, working with Local Authorities to ensure safety on highways.

48. We will use RM3 to help us assess dutyholders' health and safety management capability. Whilst all RM3 sub-criteria are relevant to achieving excellence in health and safety management, a smaller sub-set are particularly relevant to our identified priorities. These are:

- SP1 Leadership. As this involves deciding and communicating the reasons for risk controls, the importance of good management and promoting continual improvement;
- OP2 Competence Management: the reliance on human control measures, particularly in relation to the control of tram movement is managed through robust competence management arrangements. The approach to recruitment and selection, training, development and supervision is fundamental;
- PI1 Risk assessment and management: the means by which hazards are identified, risks assessed and controls created. This will ensure we review the practical introduction of the tram safety risk model across the sector, as well as issues such as trap-and-drag;
- RCS2 Management of assets: ensuring that the trams and all associated infrastructure is maintained to ensure ongoing satisfactory risk control;
- RCS3 Management of change: including Safety Verification or the voluntary application of the Common Safety Method on Risk Evaluation and Assessment. There are likely to be significant changes in the tram sector as a result of implementation of the Sandilands recommendations;
- MRA 2 Audit: Assists the regulator in forming a view of how well the tram operators are systematically checking their own risk control systems.

Annex 1: Issues around trams and tram operation

Chapter 0: Introduction - Strategy for regulation of health and safety risks

1. An important part of our risk prioritisation process is to anticipate new and emerging risks or existing risks where we foresee that their significance may change.

2. Our strategic chapters explain how we are addressing the significant risks; not cover all risks.

3. The risks that passengers and staff are exposed to on tramways differ in some respects to those on the mainline railway or on metro systems. Overall lower speeds reduce some risks, but in other aspects such as interaction with road vehicles risks are higher. This mix of risks requires ORR to have a separate consideration of the priorities in this sector.

4. The risks to the public are substantially different in tramways compared to railways. For example, the ways in which crossings of tramways are managed. The presence of trams in publically accessed areas such as roads and what are pedestrianised areas (apart from the tram) is a risk area that does not normally occur with railways.

5. Identification of Significant Risks
To do this, we use information from a variety of sources including, but not limited to:

- accident and incident data reported to us under the Reporting of Injuries Diseases and Dangerous Occurrences Regulations (RIDDOR);
- the Rail Accident Investigation Branch (RAIB) investigation findings;
- intelligence from our audit, inspection, investigation and enforcement activities;
- informed peer-reviewed opinion from specialist experts; and
- Intelligence from EU data sources and other international developments.

6. Prioritised Risks: The Pareto 80/20 principle, 80% of the effects comes from 20% of the causes is applied to help us develop a targeted approach to influence improvement in health and safety. We also consider how other issues such as Political, Economic, Social, Environmental and Legal (PESTEL) factors affect the priority given to dealing with identified risk.

7. The LRSSB is working with the tram sector to build a tram specific risk model along the lines of that already successfully used by the RSSB for the mainline railway. The model will set out the hazardous events that can occur on tramways along with their precursors and the predicted exposure levels. Over time the model will be augmented by actual data collected by the industry from the Tram Accident and Incident Recording system (TAIR).

8. The model must build not only on established patterns of incidents and accidents but encompass the potential for low frequency / high consequence events, such as the vehicle overturning at Sandilands on the Croydon system in 2016, to ensure that these are properly included in the risk considerations of tramways.

9. **Activity:** ORR will monitor the development of the tram sector risk model and the way in which operators take on board the outputs of the model to inform and develop the understanding of risk on their own systems.

10. **Activity:** As the sector continues through a period of change technologically and in safety leadership ORR will continue to consider whether the regulatory framework remains appropriate for the sector. We will consult with the sector on potential changes if the need arises.

Chapter 1: Health & safety management systems

11. While ORR has promoted the use of the RM3 model of safety management system assessment for some years now in the mainline railways and metro systems we have only recently encouraged the tramways to use RM3 as part of their own SMS audit. We will work with sector to adopt and evaluate take up of the model.

12. **Activity:** ORR's inspectors engage with tram operators and infrastructure managers to monitor and analyse safety performance, and to track progress with annual H&S plans. Inspectors expect to verify that there is a commitment to continual improvement in safety policy statements and annual plans.

13. Risk assessment remains a key feature of the management system of a company and it is important that appropriate forms of risk assessment be applied across a tramway business, from strategic issues, to operational risk, assessments that are part of change and assessments of infrastructure.

14. Inspectors will be using the RM3 criteria to assess company performance and will expect to see the self-assessments conducted by companies and the results of independent reviews of SMS'.

15. Inspectors will expect to see that companies have appropriate policies on risk assessment in place that cover all types of risks that the business and operation is exposed to.

Chapter 2: Industry staff competence and human failure

16. Given the greater reliance on human control measures in tramways compared to railways, a key risk control is the fitness and competence of staff. The approach to recruitment and selection, training, development, monitoring and supervision is fundamental to delivering this successfully.

17. This approach applies to all safety critical staff such as controllers and drivers, and also to the staff who inspect and maintain infrastructure, vehicles and systems.

18. **Activity:** ORR will continue to assess competence management as part of investigations into incidents and this is one of the core aspects of RM3 inspection. ORR will monitor the development of technologies to support driver attention and alertness by the tramway operators and how fatigue management is undertaken.

Chapter 3: Management of change

19. Strategy: We want to see that the tramway sector has in place guidance and standards that give the industry an approach to take to the management of change in their sector that allows them to manage this for themselves.

20. Specifics: Most GB tramways are relatively modern and experienced significant growth. Several systems are now into substantial expansion projects and rolling stock replacement and the change management around these schemes needs careful planning and resourcing. The situation is often complicated by major projects being designed, funded and managed by the local authority bodies that own the tram systems, infrastructure and vehicles.

21. Change comes not only from within systems but also outside it; tramways need to be aware of developments being undertaken in proximity to their systems. This relates both to potential issues during construction, and to long term issues that new developments might have on how a tramway needs to be operated. Tramways need to ensure they work with local planning authorities and also having in place systems to liaise and manage contractors working near the line.

22. Risk assessment – the mainline railway is now covered by the Common Safety Method on Risk Evaluation and Assessment (CSM-RA). Tramways continue to use Safety Verification to ensure risk is properly managed during significant change. Whilst CSM-RA is not compulsory for tramways, the principles that it sets out are not fundamentally different to expectations of how risk assessment is carried out and we will consult with the sector regarding voluntary use of the process. The formal CSM-RA process does however require the appointment of an independent safety assessor and this may not always be necessary or appropriate for a tramway project.

23. The type of risks that the assessments may need to address may also be different to those for railways, and hence need different competence sets to those who undertake railway risk assessments.

24. **Activity:** The use of inappropriate heavy-rail technology in the design of the new tramways may have led to risk being managed through operational controls instead of being designed out. We continue to check that proper risk management arrangements are used to identify appropriate standards and measures.

25. We will promote the adoption of the CSM-RA approach to risk assessment where appropriate.

Chapter 4: Crossings

26. In Great Britain it is unusual to treat the crossings of tramways and roads as level crossings in the same manner that road and railway crossings are treated. Some examples do exist (for example, Seaton Tramway at Colyford, Nottingham Tramway at Brickyard Lane, Bulwell Forest and David Lane; and Manchester Metrolink at Navigation Road are managed as level crossings rather than as road junctions). These are managed in accordance with mainline level crossings principles.

27. The majority of junctions where roads and tramways cross are treated differently to railway level crossings in that they are designed as road crossings with the usual highway traffic controls rather than the specialised wig-wag flashing lights, audible warnings and barriers seen on mainline railways. The crossings and traffic lights are the responsibility of highway authorities and the police are responsible for investigating incidents. ORR expects the tramway companies to work cooperatively with the highway authorities to monitor safety performance of crossings and to jointly take action to improve conditions where issues are identified.
The use of standard Road Safety Audit methods is expected as a starting point for considering junction safety.

28. At crossings where there are no road vehicles, just pedestrians, cyclists, horse riders etc. , collectively referred to as 'non-motorised user' or NMU crossings, ORR expects that risk assessment of location specific hazards is used to select the appropriate form of crossing and the type of warning that may be required for users.

29. **Activity:** ORR is supporting the LRSSB in the development of good practice guidance on the design and management of NMU crossings.

30. ORR will continue to investigate collisions at crossings, both to learn lessons and to check that tramways are being operated and maintained in line with good practice. Where incidents are shown to be related to matters beyond the direct control of tramway duty holders we will support discussions with local authorities and others to seek improvement.

Chapter 5: Interface System Risk

31. The consequences of failures at the interface can be severe.

Human interface

32. The control measures at the time of the Sandilands derailment in 2016 relied on timely human intervention to control the speed of the tram (operation 'system') to react to route topography, obstructions or other features (infrastructure 'system'). The causal factors that may have contributed to the incident are discussed throughout the strategic risk chapters, but specifically in:

- Chapter 1: Health and safety management systems
- Chapter 2: Industry staff competence and human failure; and
- Chapter 12: Health and safety by design.

Members of the public

33. Where trams run along roads, the greatest proportion of interface risk arises from incidents with pedestrians, cyclists and road vehicles. With the relatively low speeds involved in built-up areas, fatalities arising from such incidents are rare and trams have effective magnetic track brakes, which can stop the tram very quickly. The predominant causes of accidents are other road users running red lights at road-tram intersections or failing to comply with road signs, lines on the road, and pedestrians failing to look both ways before crossing roads. Risks can be avoided or mitigated by ensuring clear sight lines, using road markings and surface

treatments to indicate the tramway swept path, audible warnings from trams and the use of defensive driving techniques on the part of tram drivers. Lower overall speeds and better braking rates reduce the likelihood of collisions, and there is a consequent reduction in harm when collisions do occur.

34. On the mainline railway one of the greatest source of risk to members of the public (except for suicide), anywhere on the system, is trespass. Where trams operate in public spaces the concept of trespass is not relevant but there remains the risk of persons coming into contact with trams for various reasons. Line of sight operation remains key, and controls applied in an 'on street' environment remain relevant.

35. Tramway rails set in highways can create particular risks for cyclists. Bicycle wheels can be caught in the rail grooves of the tramways causing cyclists to fall from their bikes. The fall can cause serious injuries and the cyclist could then be hit by a moving road vehicle. The extent of such incidents is unknown as it does not come within scope of RIDDOR reporting.

36. To reduce the risk of such incidents we promote the provision of cycle lanes away from tramlines and effective maintenance of the carriageway around embedded tram rails.

Electrical

37. Tramway overhead line electrification (OLE): Tramway OLE shares many of the same issues as the mainline railway system. There are additional risks in the tramway context given that they run in streets to which the public have access and run close to and under buildings. This can give increased risk of contact with road vehicles, construction work and maintenance such as window cleaning. Additionally where tramway overhead line becomes dislodged and drops below its normal height this will not be detected unless it contacts the running rails or other bonded tramway structures; low hanging wires are a risk to the public.

Platform Tram Interface

38. On the mainline railway and LUL, a significant proportion of serious injuries and fatalities occur at platform train interface. This risk does not exist on the majority of tramways in the same way. This is a high area of risk on the railway due to the large vertical and horizontal distances that can exist between platforms and the floor level of trains. Tramways are normally constructed so that platforms are nominally level with tram floors, and horizontal gaps are minimised to no more than 75mm. These distances largely remove the risks of passengers falling between the vehicle and platform during boarding and alighting.

39. Additionally the majority of tramways are 'low-floor' meaning that the tram floor and consequently platforms are at around 300mm to 400mm above ground level. This also reduces the risks if passengers fall or step off a platform in comparison to the nominal 915mm high platform of a mainline railway station. The exception to this is the Manchester Metrolink, which has a 'high-floor' infrastructure.

40. The minimal gap does mean however that when a person does fall into this area in the crucial moments just before a tram passes then the consequences can be severe. The consideration of this scenario in the design of tram stop platforms and vehicles can be critical in the survivability of such incidents.

41. In general, the near level boarding of tram vehicles leads to significantly less slip, trip and fall incidents for passengers when boarding and alighting from vehicles. The ease of boarding may however encourage riskier behaviours by some passengers when doors are closing, increasing the risk of trap and drag incidents.

42. Most tram systems operate single vehicle units, but where tram vehicles are operated coupled together then there is a risk of pedestrians on platforms falling into the space between vehicles where the coupling is positioned.

Controls

43. Generally, in relation to the interface risks of tram operations, control measures rely on ensuring compatibility and cooperation with road traffic control authorities. Precautions include:

- consideration of optimum positioning of lines when designing new or extended tramways, ensuring inter-visibility (between pedestrians and drivers);
- design of tram stops and crossings to minimise risk of pedestrians crossing in front of trams;
- tram design;
- signage to warn road users and pedestrians about the presence of trams;
- offsetting tram rail in the road carriageway surface to reduce skid risk;
- optimising the layout of street furniture to reduce the secondary effects of collisions between trams and road vehicles;
- consideration of pedestrian and cyclist desire lines created or modified by the tramway, to reduce conflict points;
- tram driver competence, including defensive driving techniques; and
- educational and promotional material to raise awareness amongst the general public.

44. The Highway Code also contains specific advice for road users on tramways. It is not clear of the extent to which there is understanding of these parts of Code, particularly among pedestrians, cyclists and horse riders who are not subject to any compulsory testing on it.

45. **Activity:** ORR will continue to monitor accident reporting and engage with tramway companies as and when issues arise.

Chapter 6a: Track

46. Tramways are more modern networks than other GB rail networks and purpose built.

47. Some networks have inherited heavy rail track sections that are susceptible to the same risks as on the mainline although trams speeds are lower meaning that the track is over engineered for loads imposed by tram operations.

48. There is a particular issue about grooved rail in street-running areas where road vehicles, cyclists and pedestrians share the same space as the trams. The design and maintenance, therefore, must not introduce additional hazards to these other road users. This

also limits the design and placement of associated hardware, for example, signalling equipment.

49. A tram derailment in a congested shopping high street introduces additional risk to pedestrians and others that is not generally present in other railway networks. Derailments have occurred at the intersection between road running and track sections. The derailment of an intermediate of rear bogie may not always be immediately obvious to a tram driver and there is the potential for serious harm before they are alerted.

50. Tramways generally utilise trail-able points to make both in service and emergency facing moves. There have been a number of slow speed derailments on UK tramways where trams have “split the points” due to the point blades moving under a passing train due to incorrect adjustment of the points mechanisms. This has resulted in significant disruption and often requires detrainment with the associated risk of passenger accidents.

51. Tram vehicles are normally able to operate on gradients steeper than conventional rail vehicles, however care must be taken by designers to minimise vertical gradients and curvature where reasonably practicable.

52. It is essential that tramways have appropriate standards for the inspection of their specific infrastructure, action levels and maintenance documentation. ORR expects tramways to have robust inspection and maintenance regimes for all differing point mechanisms on GB tramways. The use of standards from the mainline railway is often inappropriate for tramway components and using such standards unquestioningly can import risk.

53. **Activity**: Wheel rail interface and derailment risk for tramways continue to be our main focus on activity in this area. We will monitor the industry’s work to improve understanding of the risk and systems to detect and respond to derailments.

Chapter 6b: Civil engineering assets

54. Primary focus on initial integrity of new operating systems and how maintained. Thus, new infrastructure generally avoids features such as deep cuttings, wherever possible.

55. The most problematic areas occur in relation to inherited heavy rail assets such as cuttings, bridges and earthworks. Even there, so far as possible, our focus has been to ensure initial integrity.

56. The information taken from safety management systems demonstrates certain operating assumptions, for example, inspection intervals, to ensure that tolerances are within a safe limit. If these operating assumptions are not followed then the infrastructure can start to degrade. Inspections have shown that some tramway companies are not good at ensuring these operating assumptions are followed.

57. Responsibility for civil engineering assets tend to rest with the highways authority. However, some tramways are responsible for significant structures: tunnels, bridges, earthworks.

58. It is essential that tramways and light railways have appropriate standards for the inspection of their specific infrastructure, action levels and maintenance documentation. The use of standards from the mainline railway is often inappropriate for tramway and light rail components and using such standards unquestioningly can import risk.

59. Where there is similar infrastructure to mainline and metro railways – primarily non-street running parts of tram networks, often inherited from heavy rail – the risks are significantly different due to the ability of trams to stop more quickly should an obstruction or other derailment risk be encountered.

Chapter 7: Rolling stock asset management

60. ORR has not noted any systemic issues with tramway rolling stock though they share some of the same issues as mainline railway stock such as the risk of 'trap and drag' incidents at doors. ORR has interest in ensuring that maintenance of rolling stock is carried out to appropriate standards. Tram vehicles that operate in street are required to have appropriate protection for pedestrians such as skirting to close to ground level and underrun protection to prevent a person who is run over going beneath the wheels. Tramcars are also expected to conform as closely as reasonably practicable to the standards for road vehicle lighting used on other large passenger carrying vehicles.

61. Trams may operate on significant gradients and also mixed with other road vehicles in streets. These situations require trams to have better braking performance than conventional rail vehicles and as such they are expected to be fitted with effective magnetic track brakes to deliver additional braking effort.

62. There can be challenges involved in the procurement of new rolling stock; modern trams come from a relatively small pool of manufacturers largely based in mainland Europe. The designs tend to be standardised to follow mainline European needs as they purchase considerably larger volumes of vehicles than the relatively small GB systems. There can be high costs associated in asking for systems specific design changes. ORR must be risk based in expectations on the design of new trams to ensure that we do not add cost to procurements by requiring features or systems that are not required by any other EU regulator.

63. **Activity:** ORR will continue to monitor operator safety performance as part of regular liaison to identify systematic failures and the activities of vehicle maintainers and operators to manage those issues.

Chapter 8: Workforce safety and Chapter 9: Occupational health

64. Robust procedures for the isolation of, and access to, overhead electrification during maintenance are an important risk control. The use of mobile plant also presents a risk to staff on the track. Key control measures are the competence of staff planning, controlling and undertaking works.

65. **Activity:** Inspectors will continue to check for effective procedures for electrical isolations and possessions.

66. On the basis of current injury and ill health data, and a lack of any intelligence from staff representatives, ORR does not believe that there are systemic problems across the tramway sector that affect the health, safety and welfare of staff. ORR will continue to monitor accident and ill-health RIDDOR reporting and engage with tramway companies as and when issues arise.

67. We continue to monitor and promote occupational health management. We undertake this primarily through regular liaison meetings, reviewing RIDDOR reports and investigating incidents and complaints on occupational ill health issues.

Chapter 11: Management of tram movement and signalling

68. Tramways in the GB are almost entirely operated on the 'line-of-sight' principle that places the driver in control of the vehicle and relies on them to manage the speed to a level that the tram can be braked to a stand before striking a reasonably visible stationary obstruction ahead; this is the same principle on which cars, buses and lorries are driven on roads. This has traditionally been accepted as a valid operating model but the event on the Croydon system in 2016 has raised questions over the degree to which simple reliance on driver behaviour remains appropriate. The industry is continuing to investigate technical methods to monitor and, in some cases, intervene automatically (e.g. speed control).

69. Some tramways operate using single bi-directional sections of route, and the use of signal passed at stop ('SPAS') warning lights and speed limits is important in controlling collision risk in these areas. Similar features are also used on some tramways at converging junctions.

70. The management of tram despatch from platforms remains an area of concern, where drivers need to both concentrate on rear-views down the vehicle side to check for trapped passengers, as well as looking ahead to ensure their route is clear. There have been a number of incidents in recent years of 'trap and drag', or drivers looking back and not forward when pulling away from tram stops.

71. **Activity:** ORR will encourage the application of effective and reasonably practicable driver supervision systems, though we recognise that these may differ from tramway to tramway depending on the operational and technical characteristics in each case. We will also continue to examine despatch policies and driver training in this area.

Chapter 12: Health and safety by design – trams and tramways

72. Requirement under regulation 6(6) of ROGS that if there is no 'transport operator' in place while a system or project is being developed then a responsible person takes on some of their duties. Those duties are the ones in paragraph 6(4) of ROGS to undertake Safety Verification (SV). In the tramway sector it is often a Local Authority body that begins the promotion and development of a new tramway or extension to an existing system, and in those cases this duty falls on that body.

73. SV requires a transport operator to ensure that health and safety considerations are incorporated into their design processes. SV is therefore entirely compatible with and a part of good Health and Safety by Design practice. The Competent Person required under SV is there to advise and comment on the application of standards and good practice and to help decide on the assessment and acceptance criteria for projects.

74. SV does not apply to all tramway projects, there is a risk and difference test built into the system to decide if it applies, but nevertheless whether formal SV is used with a Competent Person, or whether there is advice taken from an Independent Safety Advisor, the function of having some external advice can be a valuable role to help guide a project toward good practice and ensure that this is implemented properly.

75. Tramways are integrated systems that rely on the infrastructure, vehicles, operating practices and control systems to all be designed and operated in a way that ensures that together they deliver an operating tramway where risks are reduced to as low as is reasonably practicable.

76. **Activity:** Where there are new tramway works or substantial upgrade programmes ORR will expect to see opportunities takes to design out risks to health and safety at an early stage where this is reasonably practicable, and that Safety Verification is implemented properly in those projects where it is applicable. We will expect to see systems thinking in such changes.

Chapter 13: Leadership and culture

77. A positive culture is a key ‘enabler’, as it can further reduce the likelihood of a dangerous occurrence and make compliance with health and safety legislation much more likely as it promotes a willingness to think and do things in a healthy and safe way.

78. Tramway organisations should be looking to improve by:

- having a culture where there is a learning approach taken relating to reporting and discussing errors and near misses, so that the organisation develops a strong learning culture and can quickly adapt to lessons learnt and a changing environment. The development and introduction of TAIR should assist in this area;
- creating and maintaining an effective culture, to support the implementation of an effective health and safety management system. Organisations should be pro-active in monitoring what is being done to prevent accidents and occupational ill health; and
- having arrangements in place for leaders to regularly review health and safety performance and being able to take prompt action to prevent accidents and occupational ill health.

79. This will lead to stronger business performance, as good health and safety is good business.

80. Organisations with good health and safety performance have senior managers who are strongly committed to health and safety and are routinely involved in health and safety activities. There is also open communication and frequent contact between staff and managers.

81. ORR uses the Risk Management Maturity Model (RM3) to assess the issues involved in culture under a number of the RM3 assessment criteria, including, but not limited to: Criterion SP: Policy, governance and leadership and Criterion OC: Organising for control and communication. This gives ORR evidence of the effectiveness of the SMS and the commitment of leadership in maintaining and improving a positive culture.

82. **Activity:** Where ORR identifies a poor culture this will be brought to the attention of the organisation, supported by advice on the benefits of a positive culture to reduce the likelihood of incidents.

Annex 2: Table of system information

System	Year of Opening	Total Length (km)	No of Stops	Vehicles in fleet	Minimum Curve Radius (m)	Maximum Gradient (%)	Passenger Journeys 2017/2018 (Million)
Blackpool Transport	1885	18	38	18 Bombardier Flexity 2 15 Heritage	18.3	2.5	5.2
Croydon Tramlink	2000	28	39	23 Bombardier CR4000 12 Stadler Variobahn	25	9	29.1
Edinburgh Tram	2014	14	16	27 CAF Urbos 3			6.8
Manchester Metrolink	1992	97	93	120 Bombardier M5000	25	5.6	41.2
Midland Metro	1999	21	26	21 CAF Urbos 3	25	4.25	5.7
Nottingham Express Transit	2004	32	51	15 Bombardier Incentro AT6/5 22 Alstom Citadis 302	18	8.5	17.8
South Yorkshire Supertram	1994	34.6	51	25 Siemens-Deuwag 7 Vossloh Tram-Train	18	10	12.3

All systems operate at nominal 750v dc, except Blackpool operating at nominal 600V dc.

All systems work to a nominal 1,435mm track gauge

A range of statistical data on GB systems is available from the Department of Transport:

https://www.gov.uk/government/statistics/light-rail-and-tram-statistics-england-year-ending-march-2018

https://www.gov.uk/government/collections/light-rail-and-tram-statistics

ORR includes data on tramways within our main safety statistical summary:

http://orr.gov.uk/statistics/published-stats/statistical-releases

Annex 3: Comparison of tramways in scale to other rail transport modes in GB.

The table below uses statistics collected by the Department for Transport and others to illustrate the size of the tramway sector in comparison to the other rail based transport systems that ORR regulates.

	A	B	C	D	A+B+C+D	E	A+B+C+D+E	$\frac{E}{A+B+C+D+E}$
	Mainline Rail	**LUL**	**T&W, DLR, Glasgow**	**Heritage**	**Rail + LUL + Others**	**Tram**	**Rail + LUL + Others + Tram**	**Tram as % of total**
Passenger journeys (millions)	1,700	1,378	171	16	3,265	100.6	3,366	3.0%
Stations / stops	2,557	270	120	456	3,403	311	3,714	8.4%
Route Length (Km)	15,799	402	126.4	917	17,244	240	17,484	1.4%

DfT Light Rail statistics (https://www.gov.uk/government/collections/light-rail-and-tram-statistics) include Tyne and Wear Metro and DLR as well as tram systems with the Edinburgh system data reported separately. The data above has been adjusted to accommodate this.

The data on heritage railways has been taken from the annual report of the Heritage Railway Association.

The mainline railway data is taken from statistics collected by ORR and available from our website: http://orr.gov.uk/statistics/published-stats .

The data shown is for 2016/17 as this is the last full year for which data is available for all the different system types.

Annex 4 – Abbreviations and acronyms

CSM-RA	Common Safety Method on Risk Evaluation and Assessment
DLR	Docklands Light Railway
EARR	Health and Safety (Enforcing Authority for Railways and Other Guided Transport Systems) Regulations 2006 (as amended)
EU	European Union
GB	Great Britain
HSE	Health and Safety Executive
HSWA	Health and Safety at Work etc. Act 1974
LRSSB	Light Rail Safety and Standards Board
LUL	London Underground
ORR	Office of Rail and Road
PESTEL	Political, Economic, Social, Environmental and Legal
RAIB	Rail Accident Investigation Branch
RIDDOR	Reporting of Injuries Diseases and Dangerous Occurrences Regulations 2013
RM3	Risk Management Maturity Model
ROGS	Railways and Other Guided Transport Systems (Safety) Regulations 2006
RSP2	Railway Safety Principles – document 2
SMS	Safety Management System
SV	Safety Verification
TAIR	Tram Accident & Incident Recording (system)
T&W	Tyne and Wear Metro

Annex 5 – Glossary of terms

Some of the terminology used in tramways differs from that in railways

Term	Explanation
On street,	Where a tram line runs in the same carriageway as other road traffic
Segregated	Where a tramway is in a public area, but separated from other road traffic and pedestrians, except at crossing points
Off street	Where a tramway runs on its own route away from traffic. In some cases there may be a footpath or cycleway adjacent to the tramline, but there may not necessarily be a fence between that path and tram tracks.
trail-able points	A type of points that allow a tram to run through them in the trailing direction without damage, even if they are not set for that route. Avoids the need to install signalling equipment or points motors thus reducing cost.
tram	Tramcars, tram vehicle, and any other rail vehicles that operate on tramways. It includes one or more trams coupled together, and includes non-passenger-carrying vehicles
tram-train	A tram vehicle that is configured so that it can also operate on mainline railway tracks.
line of sight	Driving at a speed that allows the tram to be braked to a stand before striking a reasonably visible stationary obstruction ahead
magnetic track brake	A bogie mounted brake that clamps magnetically to the running rails to generate additional brake force by friction on the rail head. The magnetic force is normally generated by an electromagnet.
Tramway Sector	The full range of companies that operate and maintain tramways, the owners of systems and the wider supply chain. A term intended to encompass the tram industry in the UK as a whole.

Annex 6 – Legislation & codes of practice

Health and Safety at Work etc. Act 1974	http://www.legislation.gov.uk/ukpga/1974/37/contents
The Railways and Other Guided Transport Systems (Safety) Regulations 2006	http://www.legislation.gov.uk/uksi/2006/599/contents/made
The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013	http://www.legislation.gov.uk/uksi/2013/1471/contents/made
The Railway Safety (Miscellaneous Provisions) Regulations 1997	http://www.legislation.gov.uk/uksi/1997/553/contents/made
Railway Safety Regulations 1999	http://www.legislation.gov.uk/uksi/1999/2244/contents/made
Tramcars and Trolley Vehicles (Modification of Enactments) Regulations 1992	http://www.legislation.gov.uk/uksi/1992/1217/contents/made
Traffic Signs Regulations and General Directions 2016	http://www.legislation.gov.uk/uksi/2016/362/contents/made
Highway Code	Whole document: https://www.gov.uk/guidance/the-highway-code rules relevant to trams: 33, 82, 167, 183, 206, 223, and 300 to 307.

When looking at legislation please always check for subsequent amending legislation on http://www.legislation.gov.uk/ .

Annex 7 – References

Link to Tramway Safety Principles on UKTram Website - https://uktram.com/wp-content/uploads/2018/07/Tramway-Principles-Guidance-Final-2.pdf

Link to page of other UKTram guidance - https://uktram.com/documents/

Link to ORR's guide to Safety Verification for Tramways - http://orr.gov.uk/__data/assets/pdf_file/0008/28358/safety-verification-a-guide-for-tramways.pdf

List of RAIB light rail related reports - https://www.gov.uk/raib-reports?keywords=&railway_type%5B%5D=light-rail

Link to Traffic Signs Manual - https://www.gov.uk/government/publications/traffic-signs-manual

Link to ORR response to RAIB on progress with actions taken to implement Sandilands recommendations - http://orr.gov.uk/__data/assets/pdf_file/0005/39884/raib-sandilands-junction-annex-a-2018-12-04.pdf