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On the Applicability of Light Rail Safety Policies for Very Light Rail Vehicle Development

J. Winnett and D.J. Hughes

WMG, University of Warwick, United Kingdom

Abstract

The Coventry Very Light Rail (CVLR) programme aims to generate a new rail-based transport system capable of eliciting significant modal shift from personal automotive vehicles, without the significant costs traditionally associated with street-running rail schemes. Led by Coventry City Council in collaboration with WMG and Transport for West Midlands, the programme aims to address the development and delivery of the first route within Coventry, including the necessary research and development into the requisite vehicle and trackform. This will result in an affordable steel-wheel-on-steel-rail system, with a target implementation cost of £10 m/km, capable of autonomous running on-street, and that offers zero-emissions at the point of use without overhead line equipment. Part of this programme, the CVLR vehicle project aims to develop a new class of rail vehicle that offers similar levels of safety to existing public transport schemes, is low-cost, lightweight, self-propelled using zero-emission at the point of use technologies, and an attractive alternative to personal cars.

This paper addresses the safety strategy for the vehicle, although it should be noted that the process must consider the whole CVLR system.

As the vehicle will not operate on the mainline in the UK, it is exempt from the controlling measures of the Railway Interoperability Regulations (RIR). Instead, the Railways and Other Guided Transport Systems (Safety) Regulations (2006) (as amended) (ROGS) defines the processes ensuring safety and requirements for non-mainline vehicles that are excluded from RIR; as such the CVLR vehicle, and indeed system, will need to comply with relevant sections of ROGS. This can be achieved by following the principles and processes outlined in the Common Safety Methods for

Risk Evaluation and Assessment, (CSMREA) albeit with variations as required to accommodate on-street operations. The CSMREA calls for assessment against relevant standards. Whilst there is no health and safety legislation specifically for tramways, the Tramways Principles and Guidance describes the best practice and standards applicable to the light rail sector. It is not necessary for the CVLR vehicle to fully align with this, although this is the closest to an existing standard, and the base for which the application of ROGS can be determined.

Whilst specifically developed for CVLR, it is believed that adapting the CSMREA in this way complies with the ROGS regulations for any new vehicle designed for use in a light rail or tramway environment and provides a method of safely developing innovative new vehicles.

Keywords: Very Light Rail; safety policy; light Rail; rolling stock design; vehicle safety; emerging technologies

1 Introduction

Safety on all forms of public transport is of great importance due to the legal and ethical obligations for ensuring passenger and worker safety and the media attention attracted by incidents involving such vehicles [1].

Rail accidents in particular generate headlines due to their size, scale and rarity. In the late 1990s and early 2000s, a number of high profile incidents in the UK led to numerous changes in the safety systems of the whole railway system [2]. For example, the accident at Ladbroke Grove had a particular impact on the development of mainline rolling stock, with the cause of the accident linked to a driver passing a signal at 'Danger', and the severity affected by vehicle crashworthiness [3].

Such changes have had a considerable impact. It has not completely eliminated the risk of accidents occurring, with 437 accidents in 2018 on UK rail networks [4]. However, their severity has been significantly reduced, with no railway passenger or worker fatalities caused by a mainline rail accident between 2007 and 2018, although in 2018 there were 54 fatalities due to non-accident related incidents and 292 suicides/suspected suicides [4]. Comparatively, the number of fatalities due to reported road incidents was 1,782 in 2018 [5].

The Coventry VLR (CVLR) programme, a collaboration between WMG (University of Warwick), Coventry City Council and Transport for West Midlands, will develop a novel, low-cost, low-carbon rail-based public transport system for operation within the city of Coventry. It aims to deliver an affordable, marketable rail-based system, with total costs of less than £10 million per kilometre [6], capable of moving up to 1,200 people per hour with on-and off-street running alongside highway traffic, compatible with existing light rail systems and operating low-carbon self-propelled vehicles which are emissions free at the point of use [7].

The CVLR vehicle project will deliver a fully battery-powered electric rail vehicle, eliminating emissions at the point of use without the necessity for any overhead line equipment [7], with a lightweight, multi-material structure, and which is capable of

autonomous operation. Furthermore, it is expected to demonstrate applicability of new technologies to the rail industry in an operational environment.

As many of the characteristics of the system are more akin to those of a road based public transport network, the suitability of existing rail-based safety policies for application to a new VLR system, capable of both on- and off-street running, are evaluated herein.

2 Methods

There is no specific health and safety legislation for tramways in the UK [8]. The Office for Rail and Road (ORR) is the UK safety regulator and enforcing agency for light railways and tramways, with the Light Rail Safety and Standards Board (LRSSB) the dedicated safety body. The information published by the ORR regarding light rail approvals policies [9] and by the LRSSB [10] was therefore evaluated.

It should be noted there is no approval process specifically aimed at light rail; however there are schemes defined to ensure that the system will be safe. The decision as to whether operation is of a suitable level of safety lies with the operator, or a 'responsible person' where no operator is defined.

Whilst there is no approval strategy, ensuring light rail schemes offer suitable levels of safety is covered by the ORR in their 'Strategic health and safety chapter' for tramways [8]. This defines the overarching regulatory frameworks for the light rail sector as the Health and Safety at Work etc. Act 1974 [11], and the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended) (ROGS) [12], which covers all railway systems, including tramways, which are functionally separate from the remainder of the rail system and as such not subject to the Railways (Interoperability) Regulations 2011 (RIR) [13]. Alongside ROGS, the ORR have published a guidance document [14] to assist implementation of systems adhering to that framework. Additionally, the processes defined in the European Directive 'Common Safety Method for Risk Evaluation and Assessment' (CSMREA) [15], which is referred to within ROGS, have been assessed. The ORR has also published a guidance document [16] for this directive.

The LRSSB Tramways Principles and Guidance [17] guidance document governing light rail scheme development in the UK was also assessed. It should be noted this does not provide overarching processes to obtain approval, however it does provide technical advice for ensuring system safety.

3 Results

Meeting the requirements outlined in ROGS could be achieved by implementing the CSMREA [14]. Whilst the standard process is defined for mainline operations, adapting it, as defined below, will ensure safety of the system and as such provides a basis for ensuring suitable system performance:

1. **Determination of Regulatory Requirements**: The CVLR vehicle will not operate on the mainline GB railway, hence RIR is not applicable. Instead, the sections of ROGS targeted at tramway vehicles are more appropriate [14].

2. **System Definition**: In seeking formal determination that RIR does not apply, the functional, operational and interface information of the CVLR system must be fully defined.
3. **Hazard Identification**: Once the system has been defined, an analysis of the operating conditions specific to the system enables identification of hazards. Although potentially already mitigated against or not vehicle specific, all hazards are detailed at this stage.
4. **Risk Evaluation and Acceptance**: The hazards are then broken down into individual risks, each of which are evaluated and assessed. This is by assessing either adherence to the relevant codes of practice (i.e. TPG [17]), or similarity to other reference systems (e.g. buses), or by undertaking an explicit risk assessment.
5. **Standards Identification**: To implement suitable codes of practice, these are identified and analysed. The TPG [17] calls on relevant standards where appropriate; additionally, standards from other transport sectors (e.g. heavy automotive) offer potential alternatives, although justification and demonstration of suitability for a rail-based operation is required.
6. **Compliance Evidence**: The performance of the CVLR vehicle is assessed against the requirements obtained from the 'Risk Evaluation and Assessment' and 'Standards Identification' processes to ensure compliance of the vehicle.
7. **Third Party Verification**: The safety process is independently verified. For the CVLR system, this is by an Independent Competent Person, whose main involvement is reviewing safety verification documentation generated by the responsible person and providing recommendations. It should be noted it is the responsibility of the responsible person to act, or not, on these recommendations.
8. **Exported Risks**: It is likely that a number of risks cannot be mitigated, for example due to operational requirements. These risks are detailed to the railway undertaking responsible for operation.
9. **Placement into Service**: Finally, the vehicle is 'placed into service' on the first route in Coventry, with due consideration of all of the above risk assessment(s).

4 Conclusions and Contributions

The CVLR system is a rail-based transport system under development that aims to reduce the costs of light rail and tramway schemes within the UK and hence increase their affordability to small and medium sized cities. The attractiveness of tramways requires this system to offer the same accessibility into city centres, whilst removal of overhead line equipment at the same time as maintaining zero-emissions at the point of use further increases the attractiveness.

The CVLR programme is divided into separate, cross-linked projects for the vehicle, track, route and operational considerations. There is currently no defined approval process for this type of vehicle. As the vehicle operates as a tramway, this paper has assessed the approval processes typically used for light rail and their

applicability to the CVLR vehicle; it should be noted that this also requires some system considerations.

Although there is no health and safety legislation specific for conventional light rail vehicles, they need to meet the requirements outlined in the Railway and Other Guided Transport Systems Regulations 2006 (As Amended); this is also the case for CVLR vehicles. To achieve this, it is suggested that the process defined by the Common Safety Method for Risk Evaluation and Assessment is implemented. This will enable any risks associated with the vehicle to be identified, and, where reasonably practicable, mitigated against. These are:

1. Determination of Regulatory Requirements
2. System Definition;
3. Hazard Identification;
4. Risk Evaluation and Acceptance;
5. Standards Identification;
6. Compliance Evidence;
7. Third Party Verification;
8. Exported Risks; and
9. Placement into Service.

Observing the processes outlined herein are anticipated to result in a vehicle that offers a level of safety consistent with other similar vehicles in operation. This should be undertaken whilst considering the whole system, particularly due to the potential for exporting risk mitigation strategies from those that are vehicle based to methodologies that are system based.

Whilst specifically developed for CVLR, it is believed this strategy complies with the ROGS regulations for any new vehicle designed for use in a light rail or tramway environment and provides a method of safely developing innovative new vehicles.

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