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Changes to Road Maintenance and Operations on Electric Roads

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Summary

With the increased interest in electric road systems (ERS), issues regarding maintenance and operations are getting more attention. There is however mainly a focus on maintenance regarding the road surface, such as cracks, potholes and irregularities. The aim of this study was to investigate other maintenance issues that might be affected by an implementation of ERS. Comparisons were made between the maintenance and operations activities covered by a road maintenance contract and the changed activities that might come from an implementation of ERS. Activities such as roadside grass harvesting might double in cost depending on type of ERS technique.

1 Research Questions

One of the key challenges with Electric Road Systems (ERS) that concerned stakeholders when asked about implementation of ERS in the comprehensive report by TRL Limited [1] was the costs for installation and maintenance. The second concern was regarding the impact that ERS might have on existing roads and pavements. These aspects are of interest to be able to uphold safety standards and regulations of national roads, which are the main objectives of road maintenance and operations. Hence the research question is:

How will road maintenance and operations be affected by an implementation of ERS and to what extent is it reasonable to expect changes?

2 Methodology

To be able to compare or estimate differences between roads with ERS with non-ERS roads, it is important to understand the road system as well as the contract that regulates the standards and maintenance of the roads. By knowing the maintenance and operations as well as the ERS techniques used, it is possible to compare between the two systems.

Road standards in Sweden are based on parameters such as irregularities and surface roughness, rutting and macro texture (Trafikverket, 2011). The allowed levels of irregularities, rutting etc are related to speed and traffic. Specific regulations are found in each maintenance contract [2] with specific intervals for inspections, demands for repairs and allowed sizes of cracks. The maintenance contract is divided into general information, winter road maintenance, road surface, drainage, side verge area, road side establishments and road equipment.

The comparison between ERS and non-ERS is made based on the maintenance contract and the different concepts of ERS that are under development in Sweden. This study focuses on winter road maintenance, drainage, side verge area and road equipment rather than maintenance concerning road surface conditions.

Most studies or demonstrations seem to focus on the road surface conditions [1], [3] without mentioning operations such as harvesting or inspection routines. Such activities are both important for upholding safe road conditions and rather time consuming.

Where possible, methods or values from previous studies have been used for estimations. The results section will discuss possible impact that different ERS-concepts might have on the maintenance and operations of roads.

3 Results

The different concepts considered are overhead conductive technique, in or on road conductive techniques with rails in the roads and the inductive techniques that are embedded within the road construction.

Differences in road equipment

Each ERS technique will need power supply. For the sake of simplicity, it is estimated that each technique will need a power substation every km along the ERS road. For inductive as well as for conductive techniques with some sort of rail or on-road system, there is a need for extra power switching boxes, on average every 100 m. These switching boxes will be connected to the rails or inductive coils in the road, via utility cables that are laid within the road construction. Some of the conductive techniques on roads with a rail within the road are combining the power supply cables every 100 m with a drainage pipe, to be able to drain the rails of excess water.

For the overhead conductive system, poles or masts will be placed along the road every 50-60 meters, hence, extra safety rails will be needed.

These extra kinds of road equipment will impact road maintenance in different ways, mainly concerning the need for extra inspection routines.

Winter road maintenance will be affected by the conductive types of techniques in the way that maintenance contractors will have to invest in new techniques to be able to uphold the same friction levels and safety as with regular roads. It might for some techniques mean the use of specific brushes to remove snow from the rails and for others the use of a different type of snow ploughing blades [1]. The inductive techniques will probably not affect the winter maintenance of the roads in any particular way.

Drainage

Water may cause damage to the road both on the surface and in the construction. It is hence important for the contractor, to remove obstacles that causes water to dam up at the road surface, and necessary if the pool is wider than 40 cm from the road edge [2]. This may affect the maintenance of ERS roads. Rails installed in the road surface might pose as small barriers if they shot up over the road surface with only a few millimetres, causing water to dam up. Figure 1 shows an ERS solution with good alignment with an older version of the technique. It will be more important to inspect the roads and ERS solutions for cracks or discontinuities in interfaces between rails and pavement. This a time-consuming activity which will increase time and cost for maintenance and operations.

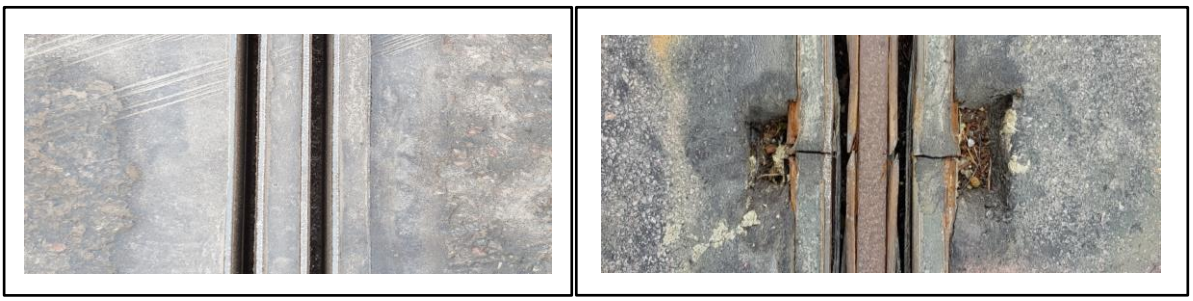

Figure 1: Example of a conductive rail ERS solution with perfect alignment with the road surface in the first picture and a more worn-down pre-demonstration test solution in the second picture. Photo: Lina Nordin and Terence McGarvey.

Some of the conductive rails within the road surface layers will combine the inground power supply cables with drainage pipes to drain the conductive rails of excess water. There is however a risk that particles deposit at the bottom of the rail, clogging up the drainage pipe. Flushing drainage pipes connected to the ERS rails every 100 m will have an impact on traffic, as well as on maintenance costs. However, before any full-scale tests have been performed, it is difficult to know how often such pipes will need to be flushed.

Side verge area and road equipment

All vegetation in the roadside area is to be cut to a width of 10 meter from the road during summer and again to a width of 1.6 meter before winter. This is a very costly maintenance activity [4]. With poles or other obstacles in the way, the time to do this is markedly increased. In a study by Bäckström (2014) measures were made regarding roadside harvesting. The tests showed that it took 17 min/km to cut grass using regular technique along roads with no safety rails compared to 35 min/km on roads with safety rails.

The intention in Sweden is to employ ERS in rural areas. Roads in rural areas are often built with safety zones where no safety rails are needed. Since the poles in the conductive overhead techniques are placed within the safety zone, there will be a need for extra safety rails along these roads. Such rails would not usually be needed along these road stretches since there is normally no road lighting along the roads in rural areas [5], [6]. This indicates that costs for harvesting along ERS roads with overhead conductive techniques might increase by 50%. According to Bäckström (2014) the annual cost for harvesting in Sweden is close to one billion SEK, which is almost one eight the total cost of road maintenance and operation every year.

Concluding remarks

Implementation of ERS will most likely affect maintenance and operations. It is however difficult to estimate the extent without large-scale tests. It is not only the obvious parts such as rutting, cracking or irregularities that will be affected, road maintenance inspection routines will have to be intensified. The ERS technique will obviously need supervision but regular inspection routines will also have to be adjusted for this new type of technique. Roads will need inspections not only regarding cracks etc. but also in terms of, for instance, to what extent rails in the road will raise above the road surface, or whether flushing of drainage pipes in the rails is needed. The largest impact might however be on the harvesting if such ERS techniques are used where safety rails are needed.

It is likely that maintenance of ERS will increase the costs of maintenance both regarding time and money.

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