Preliminary Analysis of Proposed Method for Calculating Variable Usage Charges for Control Period 5

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1.0 INTRODUCTION

Network Rail has issued a consultation paper detailing plans for implementation of revised variable usage charges for the next Control Period CP5 (2014-2017).[1] In the paper, new formulae have been proposed for calculating variable usage charges based on vertical and horizontal track damage. A hybrid formula for allocating vertical track damage was developed by Serco based on simulations using the Vehicle Track Interaction Strategic Model (VTISM). Serco issued a report that describes the methods used to develop the pricing scheme.[2] The method for allocating horizontal track damage was based on a proposed methodology developed by Transportation Technology Center, Inc. (TTCI) and Network Rail for CP4 (2009-2013) and modified for CP5 by Network Rail.

Freightliner Group Ltd estimates that, if adopted as proposed, the changes are likely to increase the charges for freight wagons in its fleet by up to 40 percent. Freightliner has asked TTCI to review the consultation paper and the Serco report and provide comments before February 1, 2013, which is the last day of the consultation period. Based on a preliminary review conducted in the time available, TTCI recommends that Freightliner request an extension to the consultation period so the issues presented below can be thoroughly investigated.

2.0 SIMULATIONS TO ESTIMATE RELATIONSHIP BETWEEN VEHICLE PARAMETERS AND VERTICAL TRACK DAMAGE

The formula for vertical track damage was developed based on simulations using VTISM, which has been established and accepted by the railway industry in Great Britain.

Serco used 48 variant cases of vehicle parameters to generate the data set for curve fitting. These included four axle loads (5, 10, 17.5, and 25 tonnes), four operating speeds (25, 50, 75, and 100 mph), and three unsprung mass variants (1,000, 2,000, and 3,000 kg). In addition, a sample of track was randomly selected for analysis, with various corrections for speed. Sampling procedures are provided in Serco's report.

However, our preliminary analysis indicates that the following factors may warrant additional investigation:

- Need to better understand the data sampling method to select the routes and their representation of the population of track in the network; i.e., Was a

[1] Network Rail, December 2012. "Periodic Review 2013 – Consultation on the allocation of the Variable Usage Charge", Web< http://www.networkrail.co.uk/publications/delivery-plans/control-period-5/periodic-review-2013/>

[2] Serco, December 2012. "VTISM analysis to inform the allocation of variable Usage Costs to Individual Vehicles", Web< http://www.networkrail.co.uk/publications/delivery-plans/control-period-5/periodic-review-2013/>

single sample pulled or were multiple samples pulled and one chosen? What process was used to select the random sample?

- For the representative route, a sample size of 5 percent with a stated +/- 1.5-percent error was used, equaling 923 miles. The selected lines were about 50 miles each. What is the error for the smaller data set? It should be different from the larger sample.
- When calculating average traffic and tonnage, what period was used to calculate the averages? Is that period representative of normal operations?
- The simulation design uses three operating conditions with four levels for axle load, four levels for speed, and three for unsprung mass. How were the values for each of these operating conditions selected, and are they representative of the majority of operating conditions?
- Is there a correlation between the three vehicle factors (axle load, operating speed, and unsprung mass)? Collinearity may artificially skew the regression analysis.

3.0 CURVE FITTING

The report concludes that the hybrid formula proposed closely represents the relative damage predicted by VTISM, and it would not be worthwhile to use a more complicated formula. However, before one can support this conclusion, it would be good to better understand the following:

- The fit of the hybrid model is described at 77 percent (page 4) and also compared to 99 percent R-square on page 33. However, these values do not necessarily describe the accuracy of the model — particularly at extreme values of the factors. In addition to the results shown, it is recommended that further analysis be conducted to determine the normality of the residuals and the variation of the fits versus the residuals.
- The charts on pages 19 to 21 illustrate the best-fit lines, which are based on three or four data points. However, the fitted lines do not appear to follow their corresponding colored data points in some of the cases. It is recommended that further review of the underlying data be conducted to understand the best-fit lines on the charts.
- There were unexpected results at operating speeds of 100 mph under all axle loads considered and at 75 mph under 25-tonne axle loads. The data was excluded for specific known causes stated as being unrelated. The model was then extrapolated for 75 to 100 mph. TTCI suggests a review of the underlying data to understand the method and confidence intervals of the extrapolation.

4.0 SUMMARY/CONCLUSIONS

Freightliner has asked TTCI to review the proposed modifications to calculations for determining vertical and horizontal damage for CP5. Based on a preliminary review conducted in the time available, TTCI recommends that Freightliner request an extension to the consultation period ending February 1, 2013, so the issues presented in this report can be thoroughly investigated.

Resolution of any of the queries recommended above could potentially have a large effect. It is our opinion that any differences are likely to be at the extremes of the factors considered; e.g., at fast or slow operating speeds or at high or low unsprung masses.

The time required to complete the recommended analysis would largely depend on the form of the original analyses, how the data is presented, and if additional VTISM runs would be required. However, TTCI expects that four to six weeks from receipt of the data would be sufficient.